The NATIONAL GEOGRAPHIC MAGAZINE

Vol. XX JULY, 1909 No. 7

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE ECONOMIC EVOLUTION OF ALASKA

BY MAJOR GENERAL A. W. GREELY, U. S. ARMY

AUTHOR OF "HANDBOOK OF ALASKA," ETC.

THE fact that Alaska is of economical importance to the rest of the United States is an opinion born of late years, which even yet is not widely disseminated. Indeed, the tenor of public knowledge on this subject was strikingly illustrated by a foot-note to an article by one of the best informed and highly esteemed of foreign writers on American subjects, whose reference to the Territory was printed, without accompanying comment, in one of the most influential and progressive periodicals of this country. The writer, referring to Alaska in 1905, said: "This vast region is inhabited by a few savages, and is not likely ever to support a population large enough to make its government a matter of practical consequence." Undoubtedly this statement represented the general opinion of intelligent men eastward of the Rocky Mountains.

It is, however, but one of the many instances in which leaders of American thought or opinion, illy informed as to Alaska, have indirectly characterized it as a land of gilded rainbows and unfulfilled promises, whose golden bonanzas are unsubstantial foundations for permanent communities, and that to there obtain a dollar in gold necessitates the expenditure of two others.

The writer holds no brief for Alaska, and makes no recommendations as to immigration or investments. In his *Handbook of Alaska* he has treated briefly such subjects of commercial interest as "Mining," "Fisheries," "Agriculture," "Forestry," "Trade and Transportation." He now yields somewhat reluctantly to the request of the NATIONAL GEOGRAPHIC MAGAZINE to consider the lines along which commercial progress in Alaska has proceeded, with pertinent comments on its interruption, diversion, and development.

The great Alaska-Yukon-Pacific Exposition is doing useful work in bringing the resources and possibilities of this valuable Territory to public notice, and many visitors will be brought to the realization that Alaska contributes its full share to the glory and support of the nation.

In considering the commercial aspects of this remote region, it is apparent that the products of Alaska, upon which all trade depends, have hitherto been drawn from three widely divergent sources—furs, fish, and gold—which will be separately considered.

WEALTH FROM FURS

Land and aquatic furs were the primary—indeed, the only—source of economical wealth in Alaska during its gov-

From "Handbook of Alaska," by A. W. Greely. Copyright, 1909, by Charles Scribner's Sons

FUR-SEAL ROOKERY ON SAINT GEORGE ISLAND, PRIBILOF, ALASKA

ernment by the Russians. Following the cession of the Territory, Congress followed the wise standing policy of Russia in adopting methods for the conservation of its extremely valuable aquatic furs. It made the Pribilof Islands, on which were situated the breeding grounds of the otary, or fur-seal, a closed reservation. As is well known, this reservation is leased for fixed periods of ten years each to the highest public bidder. The lessees are restricted as to the number and methods of taking the fur-seal, and are, moreover, bound to provide for the education and general welfare of the resident natives. This policy protected effectually the fur-seal until it faced practical destruction through pelagic sealing.

Trade in other aquatic fur-bearing animals, such as the beaver, muskrat, and otter, as well as the land fur-bearing mammals—the bear, marten, and foxes—was most fortunately controlled by a large and far-seeing corporation, the Alaska Commercial Company, which was free from an insatiate desire to exploit mercilessly the entire game of the country. In consequence the company instituted a reasonable trade policy, which looked to permanent and profitable relations with the native hunters through the years of the far future.

The entire fur trade, land and aquatic, under these fortunate conditions, began with a value of slightly over two millions of dollars, which continued until 1879, when, through the increase in the fur-seal values, it attained its maximum, averaging annually slightly over three millions of dollars for the three years from 1879 to 1881, inclusive. The average for ten years, 1879 to 1888, approximated two and three-quarters millions. Thenceforward there was a rapid decline, due almost entirely to pelagic sealing, so that in the past three years, despite a great increase in the value of furs, the entire annual catch has scarcely reached a million of dollars.

Under this judicious legislation of Congress the fur-seal was long conserved, with the prospect that it would be for centuries a permanent resource of the United States. For thirty years it yielded over one hundred thousand fur-seal skins annualy, and for the five years ending with 1888, when pelagic sealing began systematically, the average was one hundred and five thousand.

It is unnecessary to dwell on the economic evils of pelagic or open-sea hunting, whereby the females are slaughtered, the young starve, and the herd perishes. The interests of the nation, of commerce, and of the individual suffer alike, while the resident natives are reduced to hopeless beggary and ultimate starvation.

Canada observes certain regulations as to season and limits, which somewhat alleviate the evils. The Japanese sealers, however, recognize no restrictions, and frequently go to extremes, invading American territory, slaughtering the fur-seal and plundering the rookeries—in short, imitating in a small way the piratical forays of the corsairs of the Middle Ages.

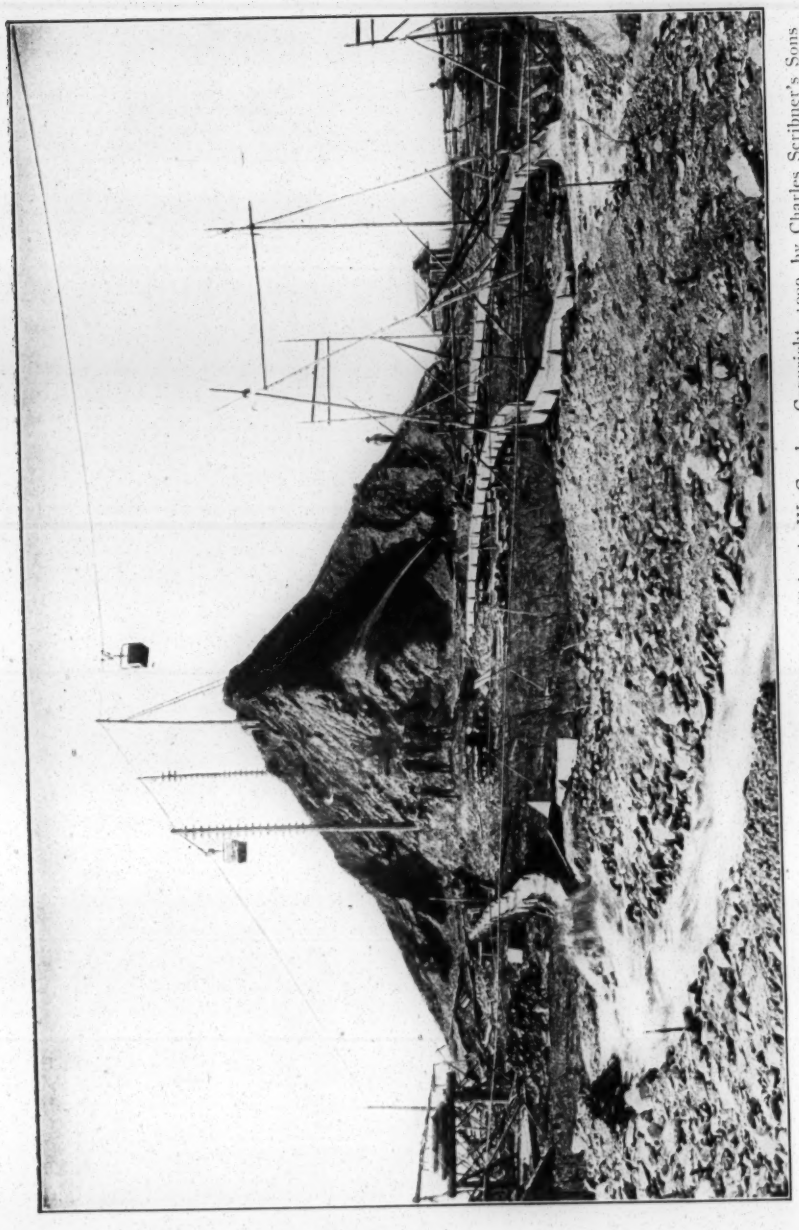
Under such unfriendly, as well as unwise, treatment, the American fur-seal herd has been practically annihilated, it having decreased 86 per cent, from an average catch of 105,000 to less than 15,000, during the past five years.

Thus vanish, through unwise and unfriendly alien exploitation, resources which for twenty years, from 1871 to 1890, produced fur-seal skins of an annual average value of one and a half millions of dollars.

Under stimulus of competition and invasion, the otter, land and sea, fell off from an average of 7,514 from 1881 to 1890 to 16 sea otter and 1,393 land otter in 1907, while the beaver similarly dropped from 6,094 annually to 1,159.

Fortunately the extent and physical features of interior Alaska afford better protection for the land animals than is possible for those of the sea. Nevertheless large immigration and improved methods of travel have affected seriously the fur-bearing mammals of the land, whose catch has fallen off 65 per cent, from an average of 106,214 from 1881 to 1890 to 46,320 during the past eight years.

Fortunately Alaska was becoming in a way independent of the fur trade as a



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PLACER MINING ON ESTER CREEK, NEAR FAIRBANKS

Washing up the dump, or frozen gravel, mined in winter

sole means of livelihood. Those who forecast commercial decay with the passing of the fur-seal were unfamiliar with the possibilities of the Territory. The seal merely gave way to the salmon.

FISHERIES

In 1868 America promptly entered the rich field of Alaskan fisheries, which in the first three years attained an average value approximating $300,000. The limited market made such a catch unadvisable, and the average fell to about $166,000 during the decade of 1871 to 1880.

A little later the market broadened in extent, and while there was a general development of the cod and halibut fisheries, there sprang into existence an industry of extraordinary importance—the canning of the salmon. From an insignificant value of $43,000 in 1881, the value of the salmon catch rose to $2,216,000 in 1889.

In short, the fisheries, principally of the salmon, showed in the decade of 1881 to 1890 an average annual increase of over $700,000 as compared with the catch of the previous decade. While the pelagic sealing most materially reduced the annual products of Alaska in five years to an amount of $1,800,000 annually, the steadily increasing values of the salmon fisheries saved the commercial situation. The salmon became second only to gold in value, financially and commercially, the catch reaching the astounding value of $10,185,783 in 1908.

GOLD

While gold is the most important of Alaskan minerals, yet copper, coal, and tin, in the order named, are destined to be factors of great economical importance in the near future.

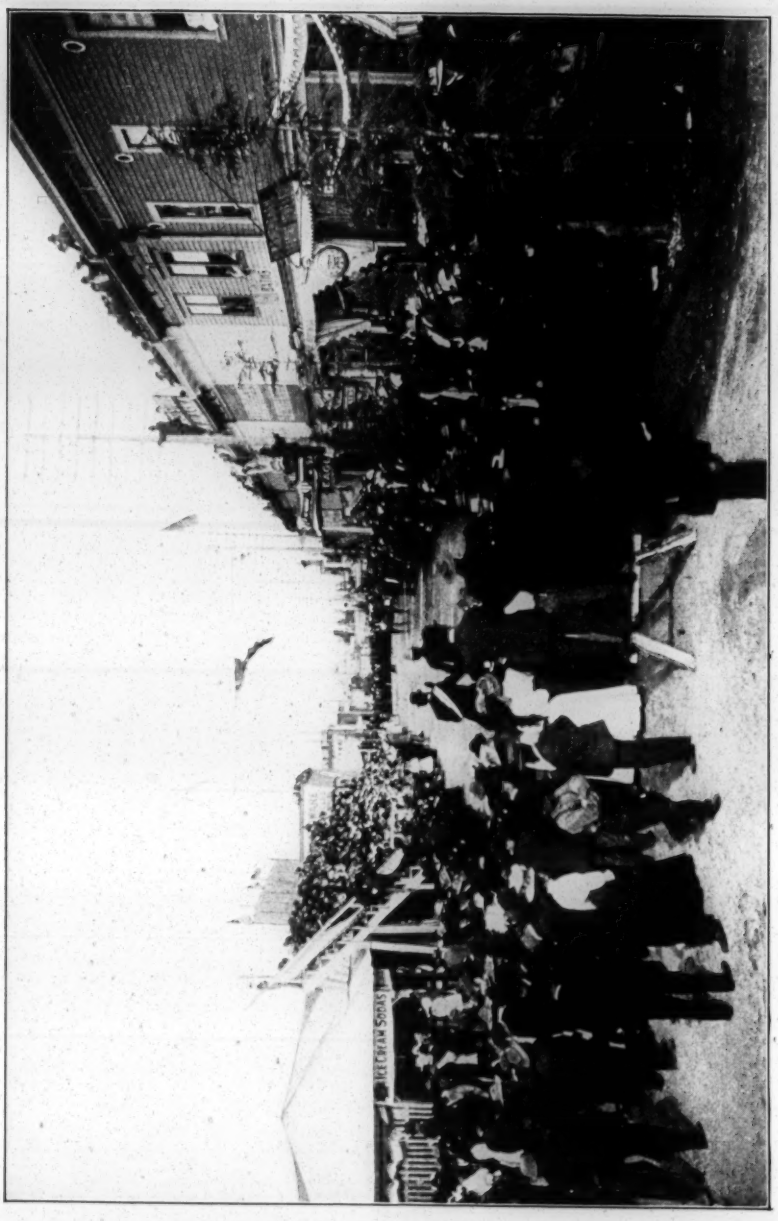
At present the dominant interest in Alaska is that of gold mining. This industry began in 1880 in southeastern Alaska, where there has been conducted for thirty years the only very successful lode mining in the Territory. The most important of these operations is the well-known Treadwell mines, which is one of the largest, most productive, and best managed properties in the world. The output of this and adjacent mines now averages about $3,500,000 yearly. The entire mineral yields of Alaska from 1868 to 1908, approximate $150,000,000, of which about 30 per cent is from the Pacific coast belt (most largely from Treadwell mines, with about $34,000,000 to date); 3 per cent from Copper River and Cook Inlet region; 32 per cent from the Yukon Basin (principally from the Fairbanks district), and 35 per cent from the Seward Peninsula (Nome).

From an insignificant output of $20,000 in 1881, the gold yield had reached $2,500,000 in 1897, prior to the Klondike discoveries. It rose to $8,000,000 in 1900 and remained almost unchanged for several years, being followed by rapidly increasing amounts as follows: 1904, nine millions; 1905, sixteen millions; 1906, twenty-two millions; 1907, nineteen millions; and 1908, twenty millions.

While estimates as to future gold productivity are most uncertain, it appears that the possible output of Seward Peninsula alone may reach in values three hundred millions. The possible yields of the Tanana watershed, as now operated, have been estimated to be at least $100,000,000. Other known fields may bring the possible yields of existing mining districts up to the enormous sum of $500,000,000. These expert opinions clearly indicate the permanency of Alaska and the great importance that gold will play therein for many years. It should be borne in mind that not a tenth of Alaska has been "prospected," and that only high-grade placers are worked under existing conditions.

TOTAL PRODUCTS OF ALASKA, 1868 TO 1908

The following table, compiled from the most accurate sources, presents, in definite and concise form, the values of what may be called Alaska's contributions to the wealth of the world, it being confined entirely to export shipments from Alaska:



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FAIRBANKS TOWN, TANANA VALLEY, ON JULY 4, 1908

Year.	Furs.	Fisheries.	Minerals.	Totals.
1868–1870.....	$2,904,064	$908,320	None.	$3,812,384
1871–1880.....	20,918,041	1,864,298	$20,000	22,802,339
1881–1890.....	25,765,320	10,006,736	4,666,744	40,438,770
1891–1900.....	11,730,696	30,989,932	28,798,742	71,519,370
1901–1908.....	9,110,708	65,380,380	114,587,245	189,078,333
Aggregate.	70,428,829	109,149,666	148,072,701	327,651,196

This table illustrates the general trend of Alaskan products, and the consequent development of special industries associated therewith.

In the total values of $328,000,000 furs have contributed 21 per cent; fish, 34 per cent, and minerals 45 per cent.

As indicative of the importance of the fisheries, it is pointed out that it was not until 1899 that their values became subordinate to those of the minerals.

COPPER

The great copper resources of Alaska have been barely touched, the output to date scarcely exceeding $2,500,000. Up to 1908 there had been mined about 105 short tons of copper, of which 60 per cent came from Prince of Wales Island and the balance from Prince William Sound. About 1,000,000 short tons are said to be now in sight, and with promising prospects elsewhere it is certain that the copper yield of Alaska will enormously increase in the near future. The contiguity of copper and coal in the watershed of the lower Copper River offers unusual advantages for economical production.

COAL

The known coal-bearing areas exceed 100 square miles, but it is estimated that there are over 1,000 square miles in the Territory. Large areas near Controller Bay and in the Matanuska Valley are covered by high-grade anthracite and semi-anthracite coals, which must ultimately be of very great value to the entire Pacific Coast region. The entire coal tonnage of Alaska is estimated at fifteen thousand millions of short tons; of this sixteen hundred millions are anthracite and five hundred millions of short tons semi-anthracite.

While questions of title and transportation are at present unfavorable to early exploitation, there is no doubt that there will be a material coal output at an early day.

MISCELLANEOUS PRODUCTS

Among other products of lesser commercial importance, under existing conditions, may be mentioned petroleum, tin, lead, silver, gypsum, marble, iron, antimony, quicksilver, graphite, and mineral waters. Timber is exceedingly valuable for local purposes, but its exploitation for export is not at all probable; indeed, its shipment out of the Territory is forbidden by law.

While the widely distributed lignitic and high-grade coals make peat of no present value, yet it will some day be a valuable asset, it being generally present in great quantities. On the Alaska Peninsula it has been found a valuable fuel in places, owing to its being saturated with petroleum residue.

The four known petroleum fields have to the present been of local value only. The abundance and consequent low price of Californian petroleum makes competition for foreign markets impracticable for Alaskan producers.

On Prince of Wales Island there are large bodies of magnetite iron, estimated as aggregating about three millions of tons.

Silver, lead, and zinc are generally incidental to gold mining. As separate ore bodies they have not yet been commercially successful, though galena deposits are considered valuable today.

Marble is now quarried in large and steadily increasing quantities.

It must not be thought that the furs, fish, and minerals of Alaska are its only resources or products. There have been built and installed by Alaskan hands and from Alaskan materials eleven incorporated cities, which are modern in their equipment and permanent in their construction. The taxable values, which are thought by many to be about one-half the true values, aggregated in 1907 $10,000,000, and the value of property in the unincorporated settlements reaches at least five millions more. The 350 miles of

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GROWING FOREST ON MALASPINA GLACIER, NEAR MOUNT SAINT ELIAS

constructed railways, on the low basis of $50,000 per mile, have cost about $17,500,000, and the cost of steamships, telephones, telegraphs (omitting the $2,000,000 plant of the United States), stage equipment and stock doubtless carries the values for transportation services alone up to $25,000,000. Ditches have already cost about $6,000,000. The output of timber and game for local purposes can scarcely be less than $2,000,000 annually, while the wood and coal locally used is not less valuable. Doubtless the agricultural products of Alaska, including dairy, stock, and fodder, reach in value between one and two millions yearly.

The commercial importance of a number of towns, such as Ketchikan, Juneau, Nome, and Fairbanks, is far beyond the usual ideas of mining camps. Take Fairbanks: Steam heated from a central plant, with water-pressure fire system, electric appliances of all kinds, with machine-set newspapers, hospitals, schools, churches, with a municipal budget of about $100,000 annually, and without debt.

It should be remembered that in these data and discussions there have not been taken into consideration the subsistence and other materials involved in the life of the 27,000 natives, whom no well-informed individual can call either savage or vicious.

TRADE

The extent, value, and scope of Alaskan trade astonishes every person who becomes acquainted with its details. As indicative of the somewhat harassing conditions under which petty trade is done, it may be stated that it is imperatively required that the trader shall have a federal license. For such licenses the people of Alaska paid in 1907 no less than $384,395.

The shipping manifests show that in 1903 the import trade of Alaska amounted to nearly ten millions of dollars. Four years later it aggregated twenty millions, slightly more than double the amount of 1903. In 1907 the purely American shipments to Alaska exceeded those to Hawaii by four millions of dollars, and those to the Philippines by thirteen millions.

These facts conclusively indicate the commercial value of Alaska, which promises to steadily advance in its population, its trade, and in all phases of a higher and better civilization.

MARKING THE ALASKAN BOUNDARY

By Thomas Riggs, Jr.

Chief of Party, U. S. Alaskan Boundary Survey

With Photographs by Boundary Survey Parties

THERE had been some dispute as to what constituted the boundary of the country bought from Russia by the United States in 1867, but until the real value of the territory was known, no one cared. The miners of the early days managed very well with an approximate boundary. They held miners' meetings and any decision reached by them constituted the law.

For the opening up of Alaska we are indebted to the panic of 1893. Throughout the West the hardier spirits preferred to brave the dangers of that almost unknown region than to accept the starvation wages then offered. They knew that grubstakes and independence were to be found on the bars of the Forty Mile, the Stewart, and at Circle City.

With the increase of population came

OBSERVING FROM "BLACK TIP," A TRIANGULATION POINT NEAR THE COAST Photo by T. Riggs, Jr.

The surveyor had to balance on his toes over a sheer drop on the other side of about 75 feet. Note the trail on the snow made in the ascent

the representatives of the American and Canadian governments, custom-houses were established and court decisions took the place of the rude justice dispensed by miners' meetings. With the new order of things came also the necessity of a determined line between the two countries.

The United States claimed, under the old Russian treaty, a line running up Portland Canal to the 56th parallel of north latitude, thence to follow the summit of the coast range to its intersection with the 141st meridian. In the absence of a definite mountain range near the coast, the line was to be not more than ten marine leagues distant from tide water.

Canada claimed that the line should follow the coast range paralleling the general contour of the coast, and cutting across all inlets and fiords.

There were other contentions of minor importance, but the real trouble was that Canada thought she was entitled to a seaport which would allow of shipments through Canadian territory to the now valuable Klondike.

As to the 141st meridian being the rest of the boundary, there was no dispute. This line starts at a ridge of Mount Saint Elias and runs through to Demarcation Point on the Arctic Ocean.

Maps showing a strip of land along the coast were made, archives were rummaged, every available bits of history and tradition were searched, and the whole mass submitted as evidence to a tribunal of three Americans, two Canadians, and one Englishman, which met in London in 1903.* The sifting of the evidence required months. The opposing counsel helped by the geographic experts put forth their best arguments, a vote was taken, and the result showed four to two for the United States, the Lord Chief Justice of England, Lord Alverstone, casting his vote with the Americans.

* For an account of this famous boundary dispute see "The Alaskan Boundary," by John W. Foster, formerly Secretary of State, November, 1899, NAT. GEOG. MAG., and "The Alaskan Boundary Tribunal," by John W. Foster, January, 1904, NAT. GEOG. MAG.

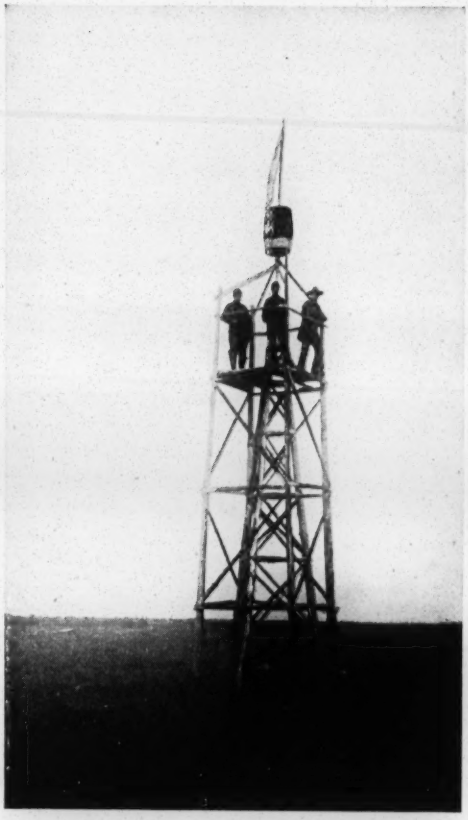


Photo by T. Riggs, Jr.

TRIPOD OBSERVING PLATFORM AND TRIANGULATION SIGNAL

Black Sand Island, near Yakutat Bay. A station elevated so as to look over near-by timber. The instrument tripod is separate from the observing platform, so that there shall be no jar. Built from drift wood. The barrel was picked up on the beach.

Naturally the Canadian representatives felt greatly disappointed, but the evidence was too conclusive to allow of any other outcome.

Then came the question of what mountains constituted the coast range. In places a compromise was effected departing slightly from the claims of the United States.

It was decided that certain well-defined peaks on the mountains fringing the coast should constitute the main points on the boundary. Lord Alverstone, wielding a

blue pencil, marked on the maps what appeared to the tribunal to be the proper mountains. The members of the tribunal were all eminent jurists, but this did not make them proficient in the intricacies of contour maps, and the advice of the experts was constantly requested.

The location of the boundary was left to two commissioners, Mr O. H. Tittmann, Superintendent of the Coast and Geodetic Survey, for the United States, and Dr W. F. King, Chief Dominion Astronomer, for Canada.

Wherever the blue-pencil mark appears on the map, this point without any recourse is a boundary point, even though a higher and better point may be but a short distance away.

To follow the sinuousities of the mountain ranges in this country would be hopeless, so the commissioners will probably decide that a straight line connecting the various blue-penciled points shall constitute the boundary.

The actual demarcation of the boundary, to be satisfactory to both governments, must be done jointly. By this it is not meant that there is a division of labor in every party. There are American parties and Canadian parties, and with each locating party, or party which decides on the line, go representatives of the other government. There are line-cutting parties, leveling parties, topographic parties, triangulation parties, and monumenting parties, which work separately, their work being such that joint representation is not always necessary, as the line will be subject to inspection at some later date. These parties report yearly to the commissioner of their respective governments. The commissioners meet sometimes in Washington and sometimes in Ottawa, and either accept or reject the work done by the field parties. Their decision is final.

A LINE 1,200 MILES LONG MUST BE MARKED

The magnitude of the task is little understood except by those closely connected with the work.

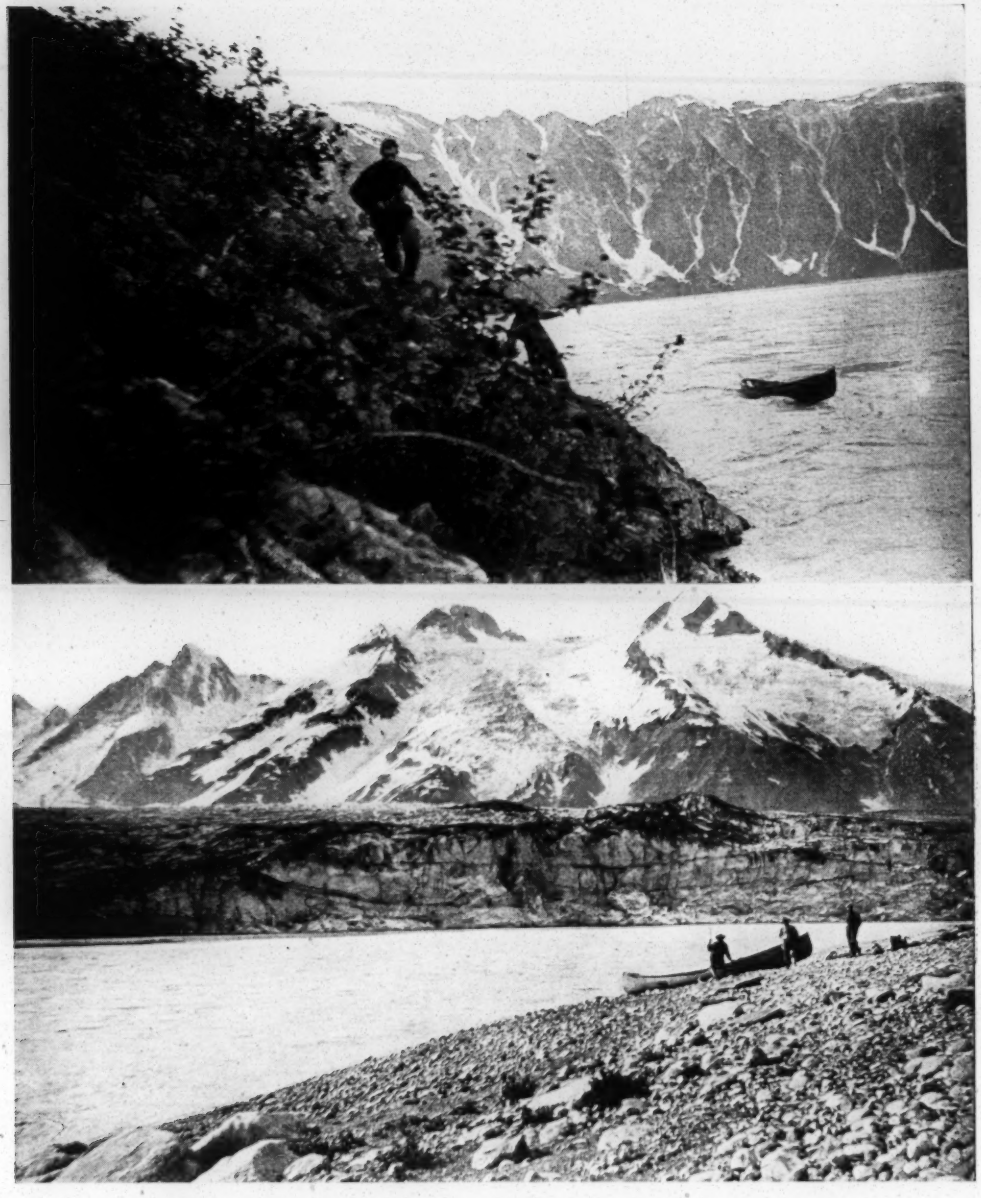
There are 600 miles of boundary from Portland Canal up the coast to Mount Saint Elias, where it hooks around on to the 141st meridian and shoots for another 600 miles straight north to the Arctic Ocean.

All the land lying along the boundary must be mapped on an accurate scale, and a strip of topography four miles wide must be run the entire length of the 141st meridian; peaks which cannot be climbed, or rather those which would take too long and would be too expensive to scale, must be determined geodetically; vistas 20 feet in width must be cut through the timbered valleys, and monuments must be set up on the routes of travel and wherever a possible need for them may occur.

The field season is short, lasting only from June to the latter part of September, and along the coast operations are constantly hindered by rain, snow, and fog. Rivers abounding in rapids and quicksands have to be crossed or ascended. A man who has never had the loop of a tracking line around his shoulders little knows the dead monotony of lining a boat up a swift Alaskan river with nothing to think of but the dull ache in his tired muscles and the sharp digging of the rope into his chafed shoulders.

Vast glaciers are to be crossed, with their dangers of hidden crevasses. More than one surveyor has had the snow sink suddenly beneath his feet, and has been saved only by the rope tying him to his comrades. Several have been saved by throwing their alpine stocks crosswise of the gap, and one, while crossing the Yakutat glacier with a pack on his back, caught only on his extended arms. High mountains must be climbed; if they are not the boundary peaks themselves, they must be high enough to see the boundary peaks over the intervening summits.

And these climbs are not the organized expeditions of an Alpine club, with but one mountain to conquer, but daily routine. Heavy theodolites and topographic cameras must be carried, and instead of being able to throw himself down to rest and enjoy the glorious panorama, there is immediate work to be done, and a few clouds hovering over some distant moun-



TRACKING UP THE ALSEK RIVER Photos by E. R. Martin

The canoe is steered from the shore by means of lines at either end

ALSEK (LIVE) GLACIER ON THE ALSEK RIVER

These glaciers make river navigation extremely dangerous. A falling cake of ice may swamp a canoe passing too near the face

DELTA OF THE ALSEK RIVER, SHOWING THE MANY CHANNELS OF THE RIVER Photo by L. Netland

tain, instead of lending beauty to the view, may send the poor surveyor behind some sheltering rock to wait, shivering with cold, until morning will allow him to take up his stand by the theodolite and complete his observations.

On the 141st meridian an astronomic longitude was determined at a point on the Yukon River. American and Canadian astronomers worked together, bringing time over the wires both from Seattle and Vancouver. An azimuth was then observed and this azimuth is being prolonged in its straight shoot across the peninsula. This line has been accepted as the 141st meridian and consequently the boundary. It has been run into the mountains fringing the Pacific coast. Topography, triangulation, line-cutting, and monumenting are now being carried along the located line.

For the present the line will not run to Mount Saint Elias. It would be possible, but not practical, to run it across the intervening eighty miles of snow and ice and towering mountain ranges. To complete this part of the boundary the use of an airship is contemplated.

Photo by G. C. Baldwin

UNLESS PROVISIONS ARE PUT IN AN ELEVATED CACHE, BEARS AND FOXES SOON STEAL THE WHOLE SUPPLY

SWAMPS AND RIVERS TO BE OVERCOME

In the interior the difficulties of the work are changed. Long wooded stretches, interrupted by barren ridges, take the place of glaciers and craggy mountains. In place of snow fields there are heart-breaking "nigger-head" swamps to be crossed, where the packhorse becomes mired and exhausted and the temper of man is tried to the breaking point. Supplies have to be ferried across the rivers on log rafts, while the horses swim. Clouds of poisonous mosquitoes and gnats arise from every pool and every clump of moss, driving horses frantic and men to distraction.

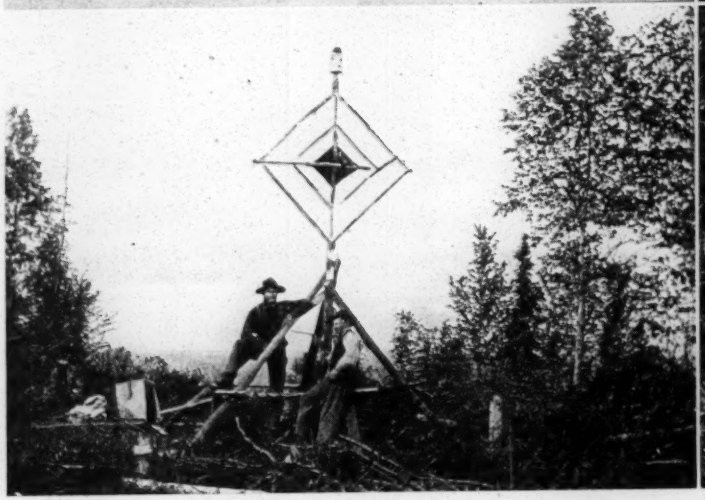
There is no longer the guiding line of the coast to follow, and the surveyor must rely on his instinct for topography and woodcraft to pilot him through an unbroken wilderness.

The inconveniences of transportation have to be overcome, and year by year they are becoming worse as the work carries us each year farther from the Yukon with its steamers. For the season of 1909 the American party of thirty men will have to walk 300 miles before they can even start work.

Then the topographer with his plane-table and the triangulator with his theodolite try to make up for lost time. Regular hours for work are ignored. A day's work is reckoned as ten hours, if the work can be done in that time; if not—well, in midsummer the days are twenty-four hours long. Holidays and Sundays see the same old routine—even the Fourth of July. It is a saying in camp

TAKING ADVANTAGE OF A FAIR WIND

On the portage between the Arku-Klin and Dangerous Rivers. As the route is largely over quicksands, an ordinary wheel would be impracticable. A substitute for wheels is found in empty oil barrels—picked up on the beach—which have floated away from some salmon cannery.



A POINT ON THE 141ST MERIDIAN

The two surveyors are the American and Canadian representatives, who jointly determine the line

A SMOKE-HOUSE FOR PROTECTION AGAINST MOSQUITOES AND GNATS

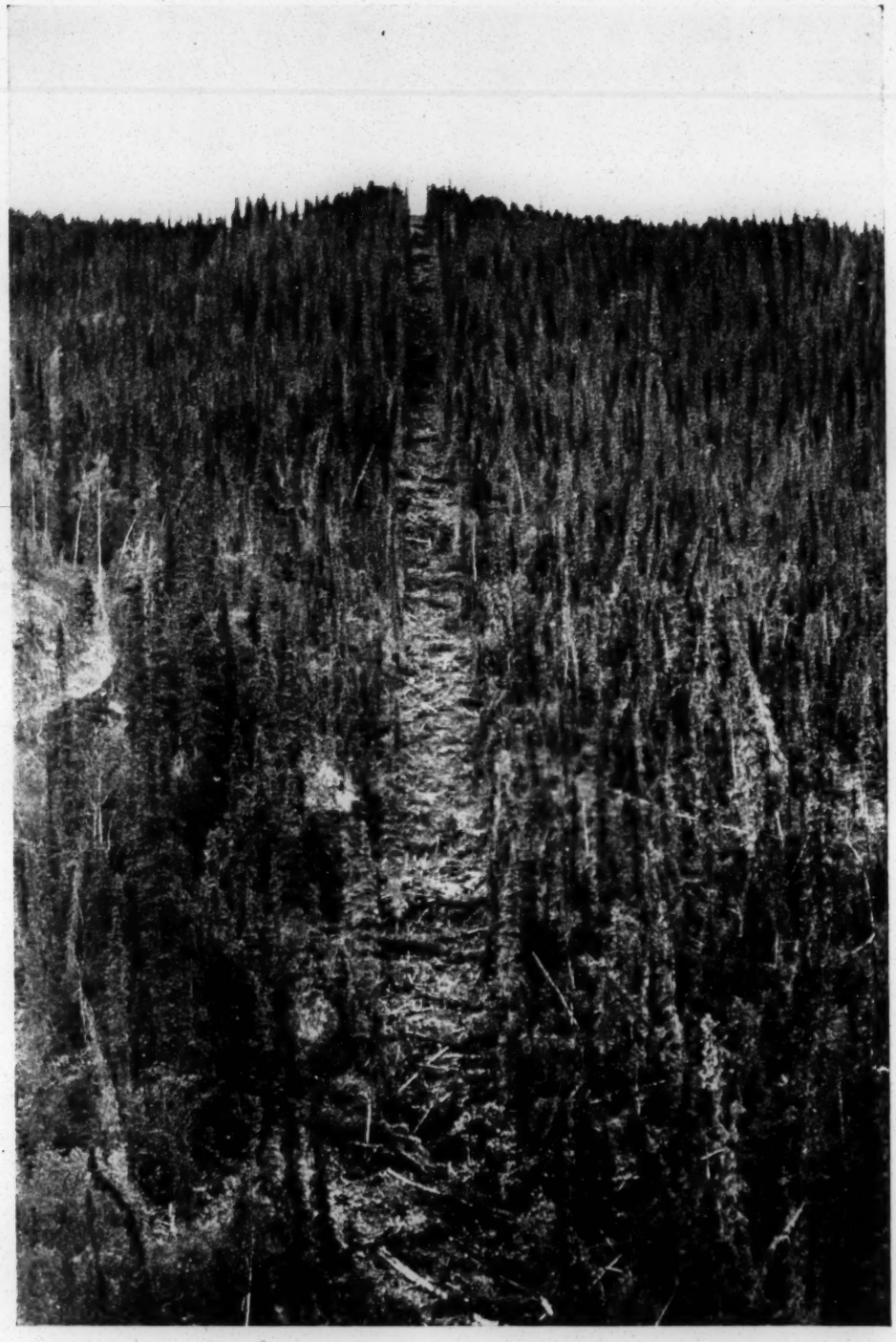
MINERS, PROSPECTORS, AND SURVEYORS ARE ALLOWED TO KILL GAME IN ANY SEASON

To their credit may it be said that they seldom abuse their privilege. Photos by G. C. Baldwin and T. Riggs, Jr.

The two surveyors are the American and Canadian representatives, who jointly determine the line

Photo by A. Mosheim

MOUNT COOK (13,803 FEET), MOUNT VANCOUVER (15,715 FEET), AND MOUNT HUBBARD (16,400 FEET)
From the summit of Mount Tebankof. These are all boundary peaks



MARKING THE ALASKAN BOUNDARY Photo by T. Riggs, Jr.

Through wooded stretches the timber is cut out for 10 feet on each side of the boundary. About 300 miles of forest boundary vista similar to that shown in this picture has been cut by the boundary survey parties.

Photo by G. C. Baldwin

NEAR THE BOUNDARY CROSSING OF THE WHITE RIVER

The straight line shows how the 141st meridian disregards the comforts of the surveyors. Mount Natazhat shown in hazy outline a little to the right of the boundary

that "it always storms on Sunday," but every storm does not bring a Sunday. Camps can be moved in a storm, and the topographer carries a small silk covering shaped like an umbrella to rig over his plane-table for showers, while the observer on triangulation has a small silk "dog" tent into which he may crawl until the rain is over.

Pack trains are constantly on the move, carrying their heavy loads of outfit supplies, while the picturesque language of the Western packer makes known the physical and psychic shortcomings of each and every animal.

Usually bases of supply are established at certain known points before the opening of the season. These are called "caches." Mistakes in the locating of a cache are sometimes made, and last season one surveyor in consequence of such a mistake was without food for two days, finally reaching another camp in rather disheveled condition. It so happened that this other party was moving south toward the same cache and was on short rations; so nothing remained to do but beat a hurried retreat 60 miles northward, arriving at another base with belts pulled in to the last notch.

To give some slight idea of the amount of work accomplished in a season, the American and Canadian parties along the 141st meridian, during the season of 1908, located main points on the boundary for 85 miles, completed 77 miles of triangulation, a belt of topography 65 miles long, cut 40 miles of vista, ran some 250 miles of levels, and set 17 monuments.

While getting in to work is quite a problem, getting out is nearly as serious. It may happen that most of the horses have died during a season. A small party of packers then drive out the surviving animals, while the main party

MOUNTAINS SURROUNDING DISENCHANTMENT BAY

Photo by A. Mosheim

When Malaspina was looking for the Northwest Passage he thought he had found it in Disenchantment Bay until he reached the point shown in the picture. Here further progress was stopped by a glacier which has since receded; hence the name

THE DISCHARGE OF THE ALSEK GLACIER, WITH MOUNT FAIRWEATHER IN THE BACKGROUND Photo by L. Netland

Mount Fairweather is a boundary peak; elevation, 15,360 feet

Photo by W. B. Reaburn

TYPE OF ALUMINUM-BRONZE MONUMENT USED ON THE MORE IMPORTANT POINTS ALONG THE BOUNDARY, SUCH AS MAIN CREEK CROSSINGS, WADS, ETC.

This monument is 5 feet high and is set in a concrete base weighing about 1,500 pounds

must get out as best they may. This is usually done on rafts. Dry logs are cut and pinned or lashed together, a sweep is put on each end, the outfit is secured in the middle, one man takes his place at the bow, another at the stern, the others distribute themselves over the cargo, and the voyage commences. No one knows the condition of the streams to be floated down. Rapids and shallows may exist; a log jam may close up the channel; overhanging "sweepers" or low bending trees line the banks and must be avoided. To change the course of a raft, it must be rowed sidewise away from the direction the current is setting it. Sometimes it runs aground, and then all must pile overboard into the icy water and work with pries until it is shoved into the deeper water of another current.

While one naturally first speaks of the hardships or seeming hardships, still camp life has its pleasures and compensations for the surveyor.

When day by day the work in hand shows another step toward completion, another stream zig zags across the map, another mountain is shown, another station occupied, something accomplished; when at night he lounges at ease before the blazing camp fire, watching the sparks snakily flashing against the dark foliage; when he wanders over the mountains and breathes the fresh air and quenches his thirst in some pure and ice-cold spring; when the inhabitants of some virgin stream are lured from their hiding places by the makeshift fly of ptarmigan feathers and string; when a juicy venison steak repays a well-directed bullet—then the small conventions and petty jealousies of civilized life fade away, and his labors are requited, and through his own exertions he is getting the best out of the life assigned to him.

On the maps, the boundary is shown all along by nice little dotted lines, but the work of putting this line on the ground is still in progress, and both American and Canadian surveyors are putting forth their best efforts to establish a boundary which will stand the test of time; so that when a hundred years hence the engineer of the period throws in his equilibrium clutch, turns on the gravity and air current absorber and brings his huge "dirigible" to a stop above some one of our stations, he may look through his improved surveying instruments along the vista from the Arctic to Mount Saint Elias and pronounce the line laid out by the old-timers straight and good.

A MOSQUITO VEIL. Photo by T. Riggs, Jr.

When mosquitoes and gnats are particularly bad, every one must wear veils, otherwise life would be unbearable. These veils are made so as to fasten down tightly around the body. The wide-brimmed hat keeps the veil from touching the face.

CHARTING A COAST-LINE OF 26,000 MILES

WHEN in 1867 the United States acquired Alaska from Russia it added to its domain the vast area of 590,884 square miles, two of its dependent islands being larger than Porto Rico.

From the point of view of the marine cartographer, the most important feature of Alaska is its great extent of coast-line. Along its general trend it measures 4,700 miles, but as the charts must show the shores of the islands and follow the ins and outs of the curves of the gulfs and bays, the length of coast-line to be surveyed reaches the enormous total of 26,376 miles. This is six times the length of the coast of France; fifteen times that of Germany; nearly eleven times that of Italy; over three times the combined length of our Atlantic, Gulf, and Pacific coasts, and is equal to five-eighths of the entire coast-line of Great-Britain and her colonies.

If a map of Alaska were to be constructed in one piece, on a scale of 1-80,000, nearly an inch to the nautical mile, and a popular scale for a coast chart, it would be 158 feet long by 105 feet wide.

At the time of the transfer of Alaska few people were interested in the territory or anticipated its future value. In fact, a special agent of the Treasury, in his report on its resources in 1869, without doubt voiced the popular opinion of the day when he advised abandoning the territory as not worth the trouble and money expended upon it.

This lack of interest continued until 1880, and during this period there was no demand for charts and no attempt was made to inaugurate a systematic survey. Compilations from the work of the early Russian and English explorers were made, and explorations were continued under our own auspices. But in 1880 Juneau's discovery of gold in Douglas Island quickly altered this state of affairs, and the great rush to many different and widely separated points on the coast began.

Immediately the inadequacy of the compiled charts became apparent. Although the work of the explorers is worthy of admiration when its amount is considered, as well as the small means with which it was accomplished and the great difficulties overcome, yet, when tested by the needs of actual traffic, the results were found to be far too meager for safe navigation. On this account for certain points vessels could not be engaged at all, for others only at exorbitant rates, and for all points the insurance premiums were high. Hence there arose an urgent demand for accurate and detailed charts—a demand which is continuous, developing new and larger wants to succeed those already satisfied.

The problem to be solved by the Coast and Geodetic Survey has been one where a nice balance had to be established between accuracy on the one hand and the pressing need for large results on the other.

Instead of being able to concentrate its field force on one portion of the coast and accomplish a steady advance with uninterrupted sequence season after season, it has been constrained to scatter its parties and follow the erratic movements of the prospector and miner.

Owing to Juneau's discovery and the development of the salmon-canning industry, the Alexander Archipelago first claimed attention. The survey of its 11,000 islands, separated by countless waterways, was in progress when the Klondike strike was made, and Saint Michaels, 1,800 miles away, became a new objective point for ocean freights, thence to be shipped up the Yukon River.

From Puget Sound to Saint Michaels the sea route crosses the Aleutian Archipelago, where large scale charts of the thoroughfares were needed. It passes by Nunivak and Saint Lawrence islands, and therefore the positions and characteristics of their nearest headlands must be laid down. Not only were the approaches to Saint Michaels surveyed, but an exhaustive examination of the delta

of the Yukon was also made in the vain hope of discovering some channel of sufficient depth for ocean steamers, and thus save the light-draft river boats the exposed trip around to Saint Michaels.

In chronological order the next mining stampede was to Nome. The field parties followed soon after the prospectors, and continued their work until the whole of Norton Sound was completed.

Latterly copper and coal interests have developed in Prince William Sound and Cook's Inlet, and surveying operations are now in progress along that section of the coast.

This necessarily irregular and haphazard program is but one of the factors which serve to retard the charting of Alaska. The prime obstacle to rapid work is the weather. Spreading out as it does over so many degrees of latitude and longitude, it has many differing climates; but in all sections bad weather is the rule and a clear atmosphere the exception. The low fogs bring all operations to a standstill, but the peculiar and most annoying feature of Alaska weather is the prevalence of high fogs, which may occur when all other surveying conditions are favorable. They hide from view the tops of the hills and mountains, needed in the triangulation and off-shore hydrography.

Field work along the coast during the winter is out of the question in all sections. From May to October is the extent of the season in southeastern Alaska. The period is shortened at both ends farther north and along the Aleutian chain of islands by early fall and late spring storms, and in the upper part of Bering Sea, still further shortened by the persistence of the ice floes, which may not disappear until July.

Up to the present time the results obtained are shown on nearly a hundred charts, the condensed and selected information derived from thousands of volumes of astronomical, magnetic, sounding, and tidal records, and hundreds of topographical sheets. One would say that by far the greater part of the coast-line of Alaska having an economic value had been surveyed, were it not for the teachings of the past, which show how vain are prophecies concerning the future of any particular part of this country of hidden wealth.

Coincident with the coast work the Survey has been engaged on the international boundary, which, owing to the peculiar shape of the territory, is 1,200 miles in length. In 1889 two parties were sent to the interior of the country to determine the intersection of the 141st meridian with the Yukon and Porcupine rivers—a hazardous undertaking at that time and full of hardships. In addition to the two years' boundary work, the leader of one expedition made a sledge journey to the Arctic Ocean, and the other a running survey of the great Yukon River.

Owing to the conflicting claims in regard to the boundary along southeastern Alaska, a large mass of data had to be collected in the field, digested, and arranged for presentation to the tribunal which finally adjusted the points in dispute. The work of locating the boundary is described by Mr Riggs on pages 593-608.

Photo by Arthur Spencer, U. S. Geological Survey

CASTLE MOUNTAIN AS SEEN FROM THE RIDGE BETWEEN GILAHINA CREEK AND LAKINA RIVER

THE MONARCHS OF ALASKA

By R. H. Sargent, U. S. Geological Survey

IF "Seward's Folly" were justified in no other way than by the purchase of this territory as a preserve of scenic grandeur, our far-sighted Secretary of State would be wholly exonerated.

After a visit to southeastern Alaska, one author of note has written: "Combine all that is best in the beauties of the Hudson and the Rhine, of Lakes George and Killarney, of the Yosemite and all of Switzerland, and you have a slight conception of the beauties of this green archipelago." Much of all this grandeur is to be found in Alaska's mountains.

Because of the comparative inaccessibility, except at great cost and much expenditure of time, the mountain districts have been visited by only a favored few. But the accounts and descriptions of these, fortified by photographs of the regions, are such as to awaken a keen desire in all lovers of nature to see them for themselves.

The steamers running to Juneau and Skagway traverse a course which is yearly pronounced by hundreds who take this trip as the most scenic upon the globe. For a thousand miles the steamer winds its way through tortuous and narrow passages, the waters of which are as smooth as a mill pond, while snow-capped peaks, ice fields, waterfalls, and green slopes pass in panoramic view before the eye.

The Coast Range of British Columbia and southeastern Alaska is an irregular mass of mountains with no definite crest line. These mountains may be considered a general northern extension of the highlands which parallel the Pacific seaboard of the United States. Along the entire coast from Seattle to Skagway, the sculpturing and general physiographic features of these mountains are such as to make them of particular interest. The broad, smooth-sided, ice-carved valleys, which subsequently were filled with water, due to the sinking of the entire region, make a very irregular coast-line, marked by numberless fiords, many of which extend far inland.

An archipelago of numberless islands, the relief of which is nearly equal to that of the mainland, fringes this entire coast-line. The passages between these islands are deep, each being remarkably uniform throughout its entire length. The mountains of both the islands and mainland rise, bold and precipitous, from the water's edge to heights of from 5,000 to 10,000 feet.

GLACIAL SCULPTURING

Many of the side valleys exhibit to a marked degree that physiographic characteristic of glacial sculpturing—the hanging valley. Often is seen, some hundreds of feet above tidewater, the broad, symmetrically carved U-shaped shelf, which, colored by the evergreens, makes a wonderful frame about the picture formed in the background by the cold gray mountains, with their snow-capped peaks, and in the foreground the stream fed by the melting snow and glaciers of the main range, plunging, roaring, often cascading down the precipitous face of the mountains for hundreds of feet.

SALMON FISHERIES

As the steamer glides past the entrance of a fiord, one catches a glimpse of a group of white buildings nestled at the base of the mountains, where the mirror-like waters of the inlet meet the precipitous evergreen slopes. An exclamation of amazement at the beauty of the picture is well nigh irrepressible. These buildings are simply one group of which there are scores along the southern coast, making one of the greatest of Alaska's industries, the canning of salmon. There are approximately 200,000,000 cans of salmon sent from Alaska each season.

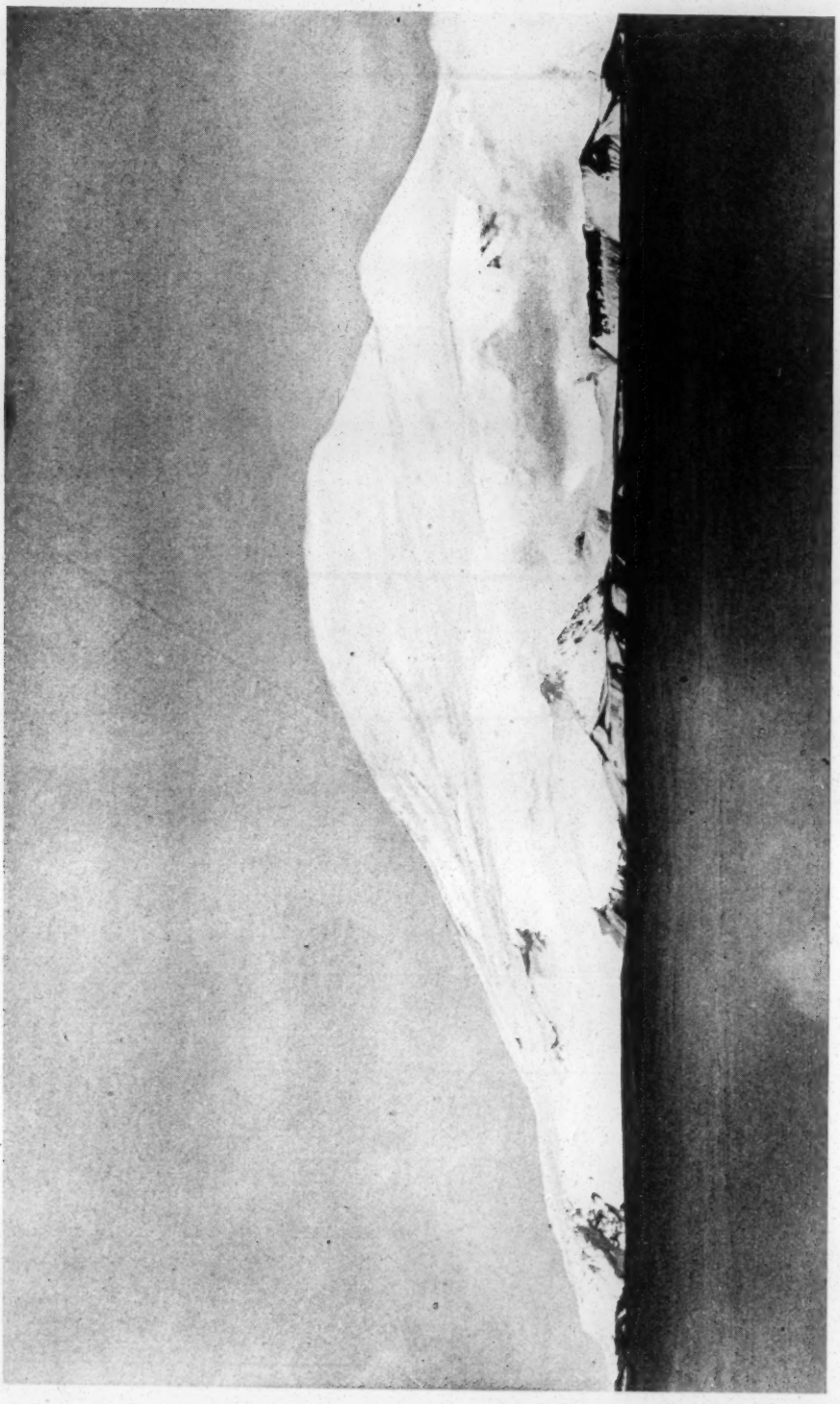


Photo by W. C. Mendenhall, U. S. Geological Survey

THE NORTHERN SLOPES OF MOUNT SANFORD (ELEVATION, 16,200 FEET), AS SEEN FROM THE BANKS OF COPPER RIVER, NEAR AHTELL CREEK

ROUTE THROUGH THE MOUNTAINS

Skagway, at the head of salt-water navigation of southeastern Alaska, is the southern terminus of the White Pass and Yukon Railroad, which is the connecting link between the Pacific Ocean and the Yukon River, the great artery of central Alaska. This railroad is one of the interesting engineering accomplishments of the age. Starting at tidewater, it follows the valley bottom of the Skagway River for about three miles, and then gradually climbs the precipitous sides, winding in and out of the smaller side valleys and canyons, frequently crossing them, until 13 miles in a direct line from the starting point it crosses the Coast Range at the White Pass, 2,888 feet above the sea. On the northern side the range slopes gently to the great interior plateau, thus making the grade of the road from the pass to Whitehorse, the northern terminus, very slight, the elevation of the latter place being 2,084 feet.

A trip to the westward from Skagway may take one either by Sitka or through Icy Strait and Cross Sound. If the former is taken, an opportunity is given for viewing Mount Edgecumbe, the only recognized volcano in southeastern Alaska. Situated as it is, just off the coast, its dome-shaped summit covered with snow, it adds much to the beauty of the surroundings of Sitka, which is one of the most picturesque spots on the globe.

If the more-frequented route through Cross Sound is taken, the progress of the steamer will undoubtedly be greatly hampered by winding its way through the waters thickly strewn with floating cakes of ice. These icebergs are supplied by the large glaciers in the vicinity; the Johns Hopkins, Muir, and Brady glaciers and many others, each being large ice-sheets covering hundreds of square miles, discharge into Glacier Bay, which opens to the Sound.

SAINT ELIAS MOUNTAINS

From Cross Sound westward the mountains increase in height and grandeur. The Fairweather Mountains rise abruptly from the ocean to heights of over 15,000 feet, while farther to the westward the range increases in elevation until, at Mount Saint Elias and Mount Logan, altitudes of 18,000 feet and 19,500 feet, respectively, are reached.

Mount Saint Elias, however, has figured in Alaskan exploration from the earliest accounts. In fact, it is the first point of the territory which was sighted by Bering in 1741. He discovered it on Saint Elias' day, and accordingly gave it the name. Singularly, it is a cornerstone of the International Boundary, since it lies practically in longitude 141° and is on the crest of the range. Here the boundary, which follows the 141st meridian, bends abruptly to the east, following the crest of the mountains.

Saint Elias, while not the highest in the group, has become the most widely known because of the numerous attempts to climb it. I. C. Russell, of the United States Geological Survey, made two attempts to reach the top. One of the expeditions of which he was the leader was financed by the National Geographic Society. His narrative of one of these expeditions was printed in the magazine in May, 1891. The harrowing experience is related of two days alone on the snow-clad sides of the mountain at an elevation of 14,000 feet, while a fierce blizzard raged and many feet of new snow were added to the old.

Russell was unsuccessful in his attempts to reach the summit, but his suggestions as to the advisable route in an ascent gave such accurate and valuable information to those who followed that the Duke of the Abruzzi, accompanied by guides, profiting by his advice, succeeded in reaching the summit in 1897.

While but 18,000 feet in height, Mount Saint Elias, as well as McKinley and many other Alaskan mountains, presents difficulties to the mountaineer not usually encountered. Unlike the majority of difficult peaks which have been conquered, where the first few thousand feet of altitude are traversed over roads or trails, the entire 18,000 feet demand ex-

treme exertion and present many obstacles to be overcome. The journey throughout its entire length being over glaciers, the unique problem of combining arctic exploration with mountain climbing is experienced.

GLACIERS AND SNOW FIELDS

The eastern part, especially the coastal slope of the Saint Elias and Fairweather ranges, is the only portion of Alaska which bears out the popular belief that the territory is covered with ice and snow. Here in the high mountains there are many Alpine glaciers and snow fields, but the Malaspina Glacier is the largest single ice field and, indeed, the most extensive on the North American continent. This great piedmont glacier spreads out over the coastal plain, presenting a front of 85 miles to the sea, and, including the névé fields which feed it, covers an area of 5,000 square miles.

This ice field is most vividly described by Russell,* who viewed it from the upper slopes of Mount Saint Elias, as "a vast, snow-covered region, limitless in expanse, through which hundreds and probably thousands of barren, angular peaks project. There was not a stream, not a lake, not a vestige of vegetation in sight. A more desolate or more utterly lifeless land one never beheld." The view of this ice field and the adjacent mountains as seen from the ocean is superb in the extreme.

This southern chain of mountains continues to the westward, where it is known as the Chugach Mountains, passing around the head of Prince William Sound and terminating in the Kenai Peninsula, where it forms little more than highlands. Just north of Prince William Sound the range is a mass of snow-clad peaks, in the valleys of which are hundreds of square miles of ice, almost entirely unexplored.

ALASKA'S HIGHEST VOLCANOES

About 150 miles to the northwest of Mount Saint Elias are the wonderfully impressive peaks of the Wrangell group, which owe their existence largely to vulcanism. There are many peaks in this group, but four, because of excessive altitude, grandeur, or activity, demand special attention.

Mount Sanford, the highest, reaches an elevation of 16,200 feet, while Blackburn is a close second at 16,140 feet. Both of these mountains are extinct volcanoes. Mount Wrangell is a great flat dome 14,000 feet high and about 25 miles in diameter at its base. It is the only active volcano of inland Alaska. Its summit is snow-covered, but surrounding the vent is a coating of ash renewed intermittently by rolling clouds of smoke and vapor which are sent up from the crater. Mount Drum, also a volcanic cone, but now deeply dissected, though but 12,000 feet high, is the most impressive one of the group. Situated as it is, well out in the Copper River plain, with nothing to detract from its grandeur, its isolation commands the observer's undivided attention.

Much of the Wrangell range is covered with ice and perennial snow, forming long, finger-like Alpine glaciers, which extend in every direction.

On the north, west, and south sides of the group the melting snow and ice of the glaciers form the tributaries of the Copper River, which flows southward through the Copper River basin, and breaks through the Chugach Mountains at about longitude 145°, for the most part in a narrow canyon. Though the Copper River in stretches is very swift and dangerous, it serves as a route of approach to the inland gold and copper fields. The canyons and rapids of the lower river, though serious obstacles to navigation, have not prevented the use of this route.

THE ADVENT OF RAILWAYS

The onward march of civilization and development, which has opened up our Western States so wonderfully, is steadily at work in Alaska. Already the screech of the locomotive has broken the silence of the mountain fastnesses, startling the mountain goats and sheep from their

*NATIONAL GEOGRAPHIC MAGAZINE, May, 1891.

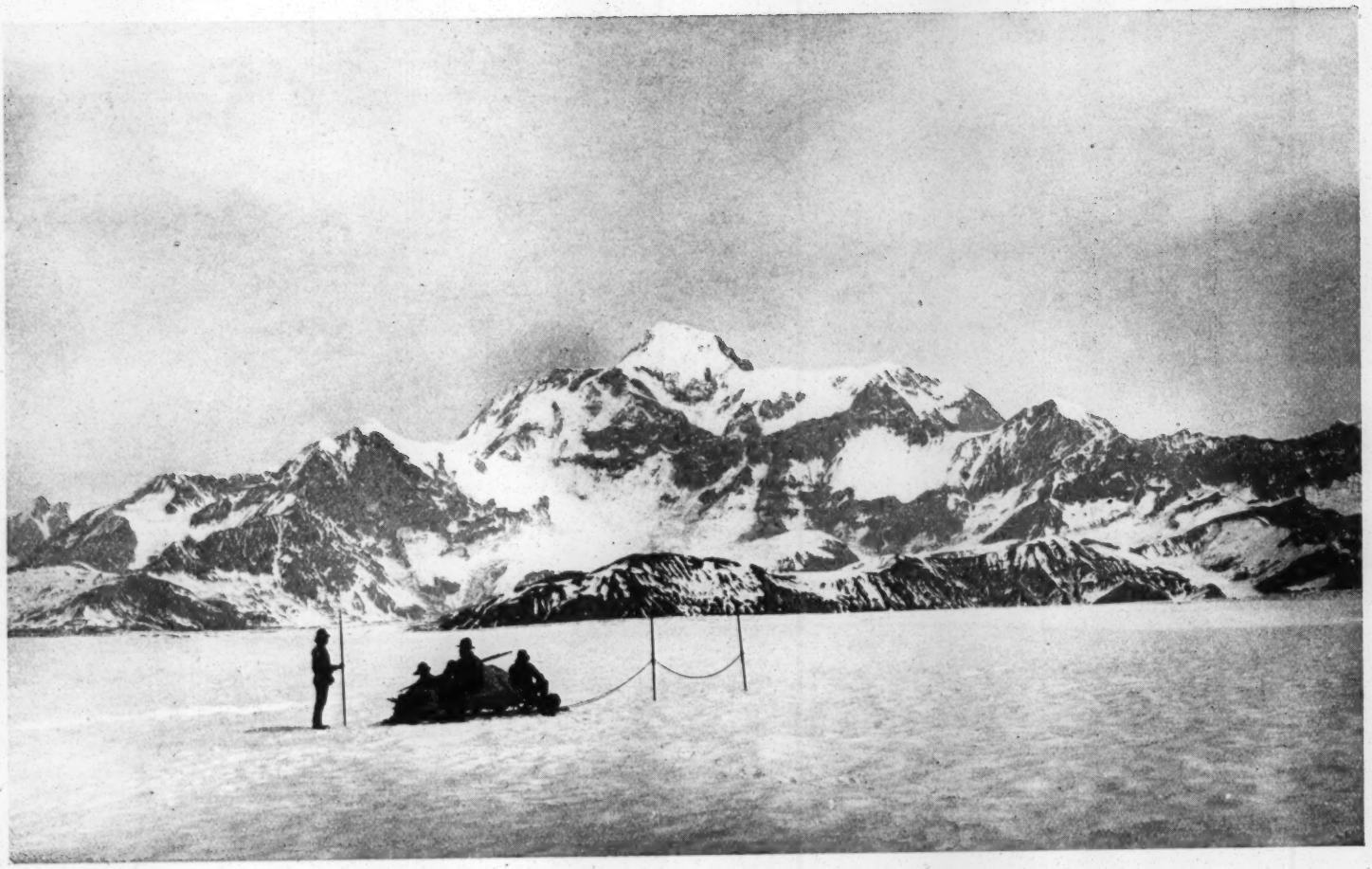


Photo by I. C. Russell, U. S. Geological Survey

MOUNT SAINT ELIAS HAS FIGURED IN ALASKAN EXPLORATIONS FROM THE EARLIEST ACCOUNTS

Photo by W. C. Mendenhall, U. S. Geological Survey

A VIEW INTO THE EASTERN PORTION OF THE ALASKA RANGE FROM THE FOOT OF GAKONA GLACIER

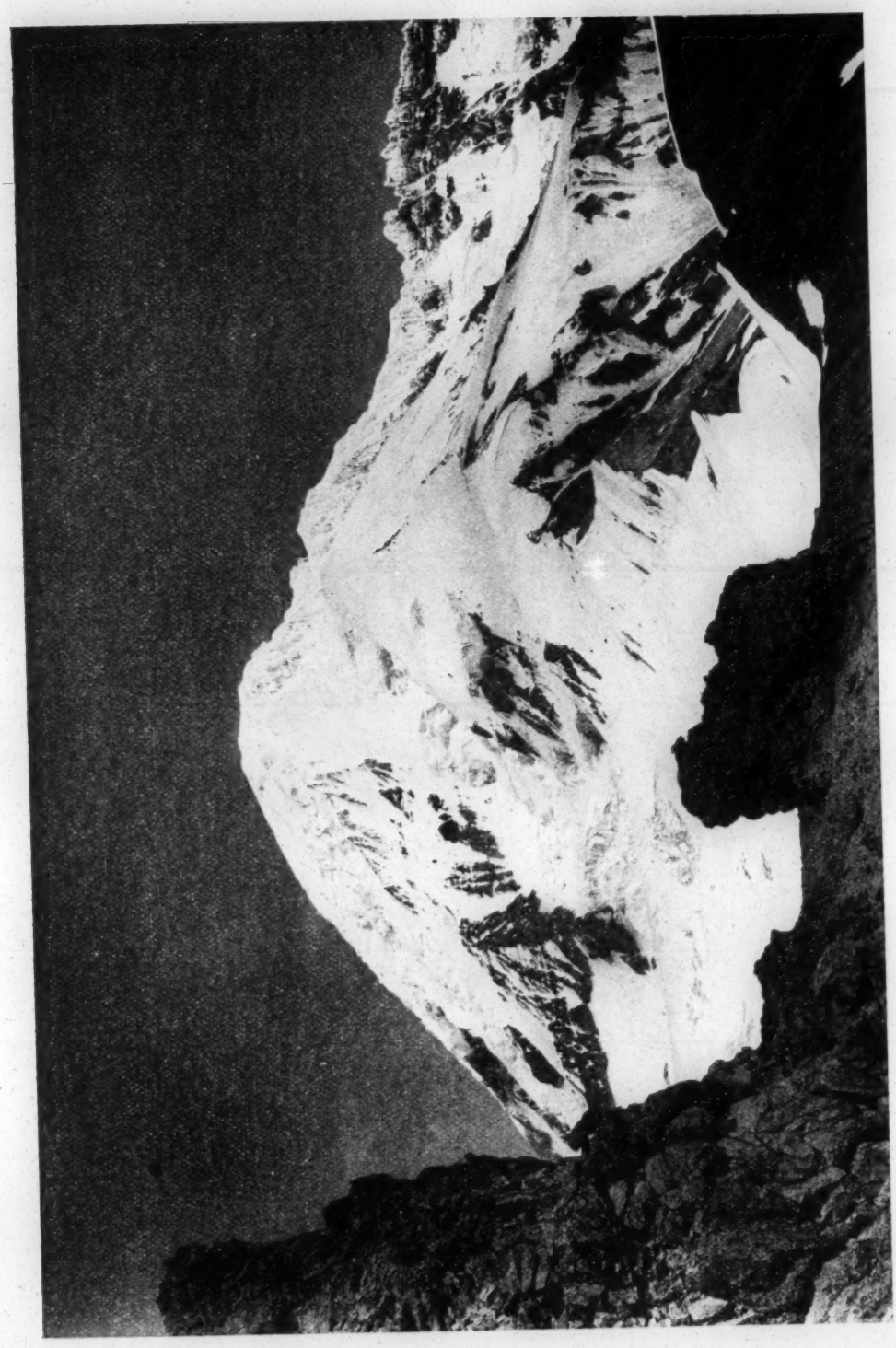


Photo by W. C. Mendenhall, U. S. Geological Survey

MOUNT DRUM, 12,000 FEET HIGH, FROM THE CREST OF THE RIDGE BETWEEN NADINA AND KLAWASINA RIVERS

Photo by W. C. Mendenhall, U. S. Geological Survey

SNIDER'S PEAK, RUGGED, ANGULAR, AND FORMIDABLE, OFTEN RESEMBLING CLUSTERS OF SPIRES

haunts among the jagged spurs along the canyons. The Copper River Railroad is being steadily advanced against the most difficult of engineering obstacles. It follows the valley of the river, crossing it twice to the present point of its construction, and another crossing will be made. If the present rate of progress continues, the road will soon reach the base of the Wrangell Mountains and thus make it possible to develop the copper deposits of that field. About two hundred miles to the west of the Copper River from Resurrection Bay northward through a low pass in the Kenai Mountains, the Alaska Central Railroad Company has commenced to build a line to the coal fields of the Matanuska Valley, and is contemplating an extension up the valley of the Susitna across a low pass in the Alaska Range to Fairbanks, on the Tanana River, and the center of a large placer district.

ALASKA'S HIGHEST MOUNTAIN

The Alaska Range stretches from a little-explored region in the vicinity of Lake Clark, west of Cook Inlet, northward for one hundred miles or more, then trends gradually eastward, increasing in altitude until in Mount McKinley it attains the remarkable height of 20,300 feet. It is broken by gaps 2,400 feet and 3,000 feet above sea-level at the head of the Yentna River, and by one at the head of the Susitna River, 1,500 feet above sea-level. The eastern end of the range rises again until at Mount Hayes an elevation of 13,800 feet is reached.

Words fail to express one's impression of the Alaska Range when viewed under favorable circumstances. In 1906, while making a trip through the Talkeetna Mountains, the writer had such an opportunity as is rarely experienced. His view was from an elevation of about 2,500 feet on the foothills on the western slope of the Talkeetna group. The day was perfect; not a cloud could be seen in the heavens. Below lay the broad, level valley of the Susitna River, beautifully carpeted in the deep green of the coniferæ, while here and there a shining patch of light, outlining a lake, broke the monotony, and through the center of it all the Susitna wound like a silver trail.

Across the valley, 50 miles away, the foothills of the Alaska Range rose, rugged, angular, and formidable, their cold, gray, serrated peaks often resembling clusters of spires; while back of them, dwarfing to the height of mere foothills in comparison, Mount Dall, Mount Russell, and Mount Foraker stood like white-clad guardians to their chief, Mount McKinley, towering grand, superb, indescribable, 20,300 feet above the sea. A sweep of the horizon from the south to the northeast, where the view was cut off by the adjacent mountains, gave the grandest panorama imaginable. Far away in the distance could be seen the volcanoes Iliamna and Redoubt, on the western shore of Cook Inlet, while at the other extremity Mount Hayes towered high above everything about it. Between these two extremes the waving crest-line of the range was now painted in the green of a river valley, now cold, steel gray, as it outlined the lower peaks, gradually becoming whitened as it reached its crest, and then on through the same transition until lost to view—a memory which can never be taken from me.

Under favorable conditions, Mount McKinley can be seen for a distance of 150 miles, a huge sugar-loaf mass, towering high above everything about it. To the Russians it was known as "Bulshaia," while the natives of Cook Inlet called it "Traleika," both meaning "big mountain." The present name was given it by W. A. Dickey, who in 1897 ascended the Susitna River for a short distance, and was the first to call attention to the great height and the location of this magnificent peak. He made a bold guess at its altitude, which was confirmed three years later by Robert Muldrow, of the United States Geological Survey.

Just south of McKinley is Mouth Disston, a triple peak, following it a close second in height. Farther south along the range are Mount Foraker, 17,000 feet, Mount Russell, 11,300 feet, and

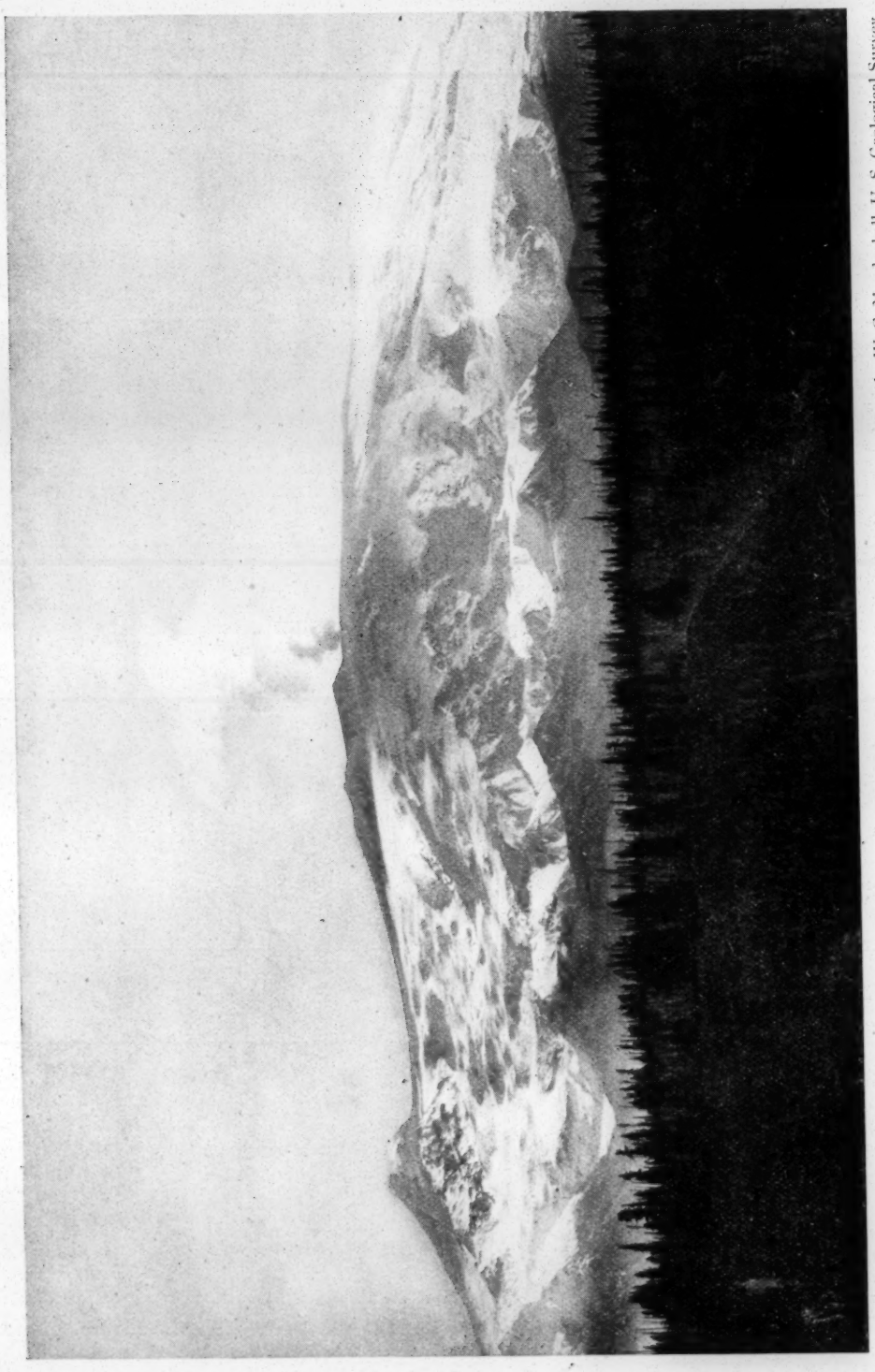


Photo by W. C. Mendenhall, U. S. Geological Survey

MOUNT WRANGELL: INTERMITTENTLY ROLLING CLOUDS OF SMOKE AND VAPOR ARE SENT UP

Photo by W. C. Mendenhall, U. S. Geological Survey

MOUNT DRUM: ITS ISOLATION DEMANDS THE OBSERVER'S UNDIVIDED ATTENTION

MOUNT MCKINLEY, ALASKA'S HIGHEST MOUNTAIN (SEE PAGE 619) Photo by Judge James Wickersham

Mount Dall, 9,000 feet; while farther yet to the south, across the valley of the Skwentna, is Mount Spurr, 10,500 feet high.

Above 9,000 feet the mountains are perpetually covered with snow and ice, and at their bases, on either side of the range, long tongues of ice shoot out, filling the valleys in the neighborhood of Mount McKinley in some instances for a distance of 25 miles.

Nothing was known of the region adjacent to Mount McKinley until in 1902 Alfred H. Brooks, accompanied by L. M. Prindle and D. L. Reaburn, all of the United States Geological Survey, were the first white men to reach its western slope. In 1906 Dr Cook succeeded in reaching the top, making the ascent from the east. Mount McKinley is the only one of the many snow-covered peaks of the Alaska Range which has been climbed. Indeed, even of the immediate locality of the others very little is known.

THE COASTAL VOLCANOES

The chain of volcanoes, active and extinct, which follows the Pacific coast from Cape Horn, north through South America, Mexico, the United States, and Canada, has it representatives along the Pacific coast of Alaska also, even to the extremity of the Aleutian Islands. Mention has already been made of Mount Edgecumbe, in southeastern Alaska, and those of the Copper River region.

The largest zone of volcanic activity in Alaska is from the west shore of Cook Inlet, at Redoubt Mountain, southwestward throughout the entire length of the Aleutian range. Practically the entire range is composed of volcanic ejecta. There are many beautifully shaped cones of extinct craters, while a few are active at the present time. Among these Iliamna and Saint Augustine are in the northern portion of the range, the latter being located on the island of the same name. On Unimak Island, the first of the Aleutian group, there are two active craters, Sishaldin and Pogromi, and on Unalaska Island, 100 miles to the southwest, is Makushin.

The mountains of the Aleutian Islands are not so high as those of the mainland, Sishaldin being about 8,000 feet, while Makushin is not over 4,500 feet.

About 50 miles to the west of the north end of Unalaska Island, in latitude 54° and longitude 168°, lies the magic crater Bogoslof. Though insignificant in size, in comparison with the less active craters of the group, it is not lacking in interest. So rapid are the diastropic and volcanic metamorphoses of Bogoslof that it was at one time a volcanic cone 450 feet in height, with an island of 2 square miles at its base, and 10 days later a subsidence had taken place, until scarcely more than 40 feet relief remained and the island was reduced to a few acres. The fluctuations between elevation and subsidence are so frequent and radical that it is never safe to announce its condition at any stated time.

The facilities for travel by trails, wagon roads, steamers, and railroads are steadily increasing, and within a very few years many of the now comparatively inaccessible regions will be easily reached. Such a condition will not only open to the general public a region unsurpassed in scenic grandeur, with many opportunities for the professional mountaineer, but will be instrumental in advancing the territory's commerce, mining, and agriculture.

THE BIG GAME OF ALASKA *

By Wilfred H. Osgood, of the U. S. Biological Survey

ALASKA is not, like Africa, a country where great herds of game of many kinds are seen even by the passing traveler; yet in its various parts our northern possession is the home of many important game animals, including some which are the largest and finest of their kinds.

Owing to the diverse topography and range of climatic conditions within the territory, the game is not uniformly distributed; indeed, there are many large areas in which game of any kind is exceedingly scarce, and doubtless this was true even before the days of the gold-hunters. But within its chosen haunts each of the various game animals is abundant. In the extensive forests of the interior the giant moose stalks about in silent majesty, while on the surrounding peaks of the highest mountains of North America the agile mountain sheep follows its roughly beaten trails over the pinnacles.

On the bleak tundras of the Arctic coast, as well as on the treeless mountain slopes farther south, herds of caribou rove in countless numbers. Even among the ice floes of the frigid Arctic one may encounter the great polar bear and the huge, awkward walrus. In contrast to these is the graceful little Sitka deer, an animal of southern affinities, which threads its maze of trails in the luxuriant vegetation of the southeastern coast district. To this attractive picture for the big-game hunter is still to be added the grizzly and black bears and the great fish-eating brown bears of the Alaska Peninsula.

But Alaska's game is scarcely of more interest to sportsmen than to the pioneers who live their lives in the great northern territory and greatly appreciate a fare of juicy moose or caribou meat instead of salt pork. Fortunately both sportsmen and Alaskan residents are becoming awakened to the need of husbanding their stock of wild game instead of sacrificing it to immediate desires. Laws are difficult to enforce in a frontier country and the safety of game lies largely in the fostering of good public sentiment. Alaska can no more afford to waste its game than its fish, forests, or minerals.

In the United States and the Canadian provinces a tardy appreciation of the value of game and an apprehensive realization of its impending extinction are causing the enactment of many stringent laws, while not a few sanctuaries or game refuges are being set apart. In many cases the game is disappearing, not because of unrestricted killing, but on account of a reduced food supply, the winter range of the animals having been occupied for agricultural purposes. Notwithstanding the rapid economic development of the territory, it is unlikely that such conditions will ever exist in Alaska, and the necessity of restocking the natural preserves there need never arise if suitable preventive measures are taken before it is too late. The range for game in Alaska will remain indefinitely; our obligation is only that of saving the animals themselves.

Taking up the game animals of Alaska individually, we may begin with the largest, the moose.

THE ALASKAN MOOSE IS THE BIGGEST MOOSE KNOWN

Both the well-known moose of eastern North America and its relative, the elk of the Old World, are surpassed in average size by the Alaskan animal, which zoölogists distinguish as a separate variety (*Alce americanus gigas*). Its antlers are particularly large, having an average spread of from 5 to 6 feet, and in no small number of recorded instances even exceeding 6 feet. Moose are generally distributed throughout the forested parts

* Several of the author's photographs illustrating this article were taken on the Canadian side of the line in the Yukon Territory, but the scenes and animals are characteristically Alaskan.

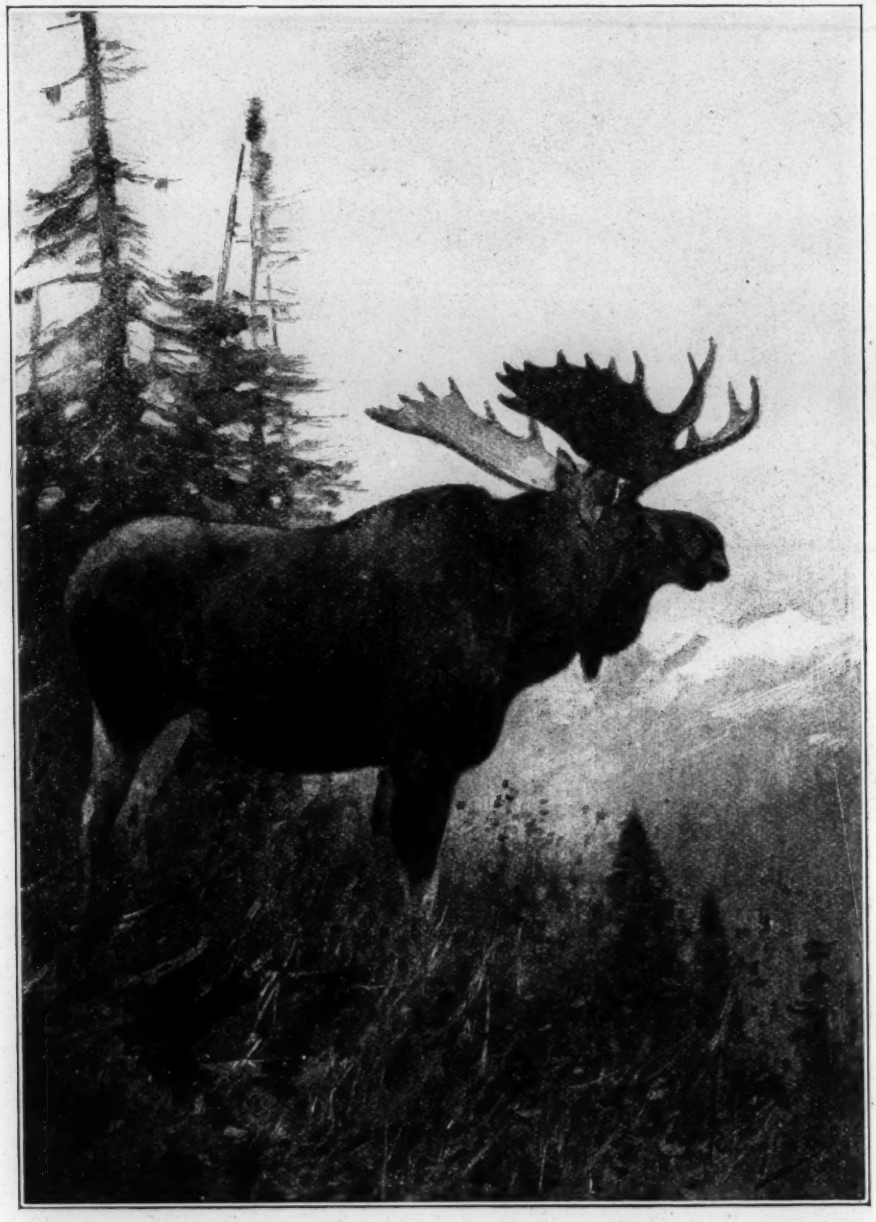


Photo from U. S. Biological Survey

THE ALASKA MOOSE (ALCE AMERICANUS GIGAS)

A MOOSE WHICH FELL CONVENIENTLY ON THE BANK OF A TRIBUTARY OF THE YUKON

of Alaska, except in the coast district south of Cook Inlet, where they are wanting. On the Alaska Peninsula they range to the limit of timber, and in the north and west likewise reach the edge of the tundra. Although spending most of their time in mixed woods of spruce, poplar, and birch, at moderate elevations, they frequently ascend to open mountain ridges above the timber.

Once while following a sheep trail among the almost inaccessible pinnacles of Glacier Mountain west of Eagle, Alaska, I was greatly surprised to find signs of moose. Although knowing that moose often range above timber, not only under stress of circumstances, but also through choice, I scarcely expected to find them in these barren, jagged rocks, through which a man could travel only with great difficulty. Proceeding for about half a mile, during which the country became more and more rugged, I soon found the trail strewn with bones and came finally to a large skull, nearly perfect, and bearing the antlers of a large old bull moose. Just how the big fellow met his death can scarcely be known, but little imagination is required to produce a thrilling tale of tragedy. Signs of wolves were found near by, but that they were contemporaneous with the bones could not be ascertained. The pinnacles of Glacier Mountain are the highest in the entire region, and from the spot where the bones lay one can look across billows of mountains down to the shining Yukon and on beyond to the high peaks of the Ogilvie Range. What a setting for a mortal combat, if such there was!

Sportsmen hunting moose in Alaska usually follow the method known as still hunting, while the meat hunters, like the Indians, frequently practice the lazy but effective plan of lying in wait near trails, ponds, licks, or other places to which the animals regularly resort. But calling with the birch-bark horn, as practiced in eastern Canada, is seldom attempted, and

A VERY LARGE BULL CARIBOU KILLED ON THE FLAT TOP OF A HIGH MOUNTAIN

perhaps on this account the statement is often seen that the Alaska moose will not respond to calling. That it does do so I am amply convinced by an experience in the Yukon Territory while hunting with Mr Carl Rungius the well-known painter of big game.

One September evening in a good moose country we took a position on a slight elevation overlooking a sparsely wooded flat and began calling. Mr Rungius, who had had experience in New Brunswick, handled the trumpet. After the fourth call a faint rattle of horns was heard in the distance, perhaps half a mile away. Another call and the horns rattled again, this time a little nearer, and soon no doubt remained that a bull moose was coming directly toward us. No animal but a moose could make such a noise. For a time all would be deathly still, and then, crash! as the horns rattled their challenge against the resonant branches of a dead tree. Not long after a second animal was heard coming from another direction, and eventually the ghostly form of a very large moose carrying massive antlers stalked in full view across an opening in the trees some 300 yards away; at the same time another, perhaps younger and smaller, was coughing and grunting in a thick clump of trees not 50 yards from us.

CARIBOU

The caribou of Alaska consist of several varieties closely related to or identical with the barren-ground caribou (*Rangifer arcticus*) of north central Canada. They inhabit the treeless mountain ridges of the interior and the rolling tundras of the coast from the Arctic Ocean to the Pacific side of the Alaska Peninsula, feeding almost exclusively on the delicate greenish white lichen called reindeer moss, which grows abundantly throughout the region.

Owing to their highly gregarious habits and their general stupidity, the caribou are likely to be among the first of Alaska's game animals to be extirpated. In spite of the open nature of their habitat, they are not sharp-sighted, but depend almost entirely upon scent

Photo from F. H. Moffit, U. S. Geological Survey

SMALL BAND OF DALL'S SHEEP NEAR THE HEAD OF THE NABESNA, A TRIBUTARY OF THE COPPER RIVER

for protection. In the mountains between the Yukon and Tanana rivers, where I once enjoyed the privilege of seeing several hundred caribou within a few days, I repeatedly put this to the test and was amazed to find such helpless and naturally timid animals so lacking in powers of observation. While I sat or stood within full view they came down the wind directly toward me without the slightest sign of alarm until within a few rods. Several times small herds passed within 50 yards utterly oblivious to danger until reaching a position where the wind blew from me to them, when they immediately became terror-stricken. Curiosity also is one of their failings, and it may readily be believed, as often stated, that a man on horseback, by taking a prominent position on an open hilltop, will attract any caribou that may be in the vicinity. More than once while skinning a dead caribou I have been interested to see several of its one-time comrades circling about, coming again and again within 50 yards to stand and watch for a moment and then dash wildly away.

It has never been my good fortune to see more than 40 or 50 caribou at one time, and although such enormous herds as are reported on the Canadian Barren Grounds have never been seen in Alaska, there is much reliable evidence that herds numbering several thousand animals are still to be seen there.

MOUNTAIN SHEEP

The well-known bighorn or Rocky Mountain sheep, formerly so common in Colorado, Montana, and other Western States, does not extend to Alaska, but is represented there by another species (*Ovis dalli*) of slightly smaller size, more slender horns, and pure white color. Like other mountain sheep, this species spends most of its life above timberline, even remaining among the heights during the severe northern winter. This is perhaps not such a hardship as might be supposed, for the irregularities of the cliffs and gorges often afford more op-

portunities for shelter and exposed food supply than might be found on the more level ground of the lowlands. In summer the sheep feed mostly on the open slopes, luxuriant with low, matted vegetation, and in the beautiful saucer-like basins lying just below the ultimate heights. Unlike the caribou, they are very keen of vision and depend little upon scent for warning of danger. As a test of this I once sat in a concealed position above a small band of them and lit my pipe and watched the smoke drift toward them on the light breeze. They gave no sign of alarm, but continued feeding until I showed myself, when they precipitately took to flight.

The white color of these sheep, as might be supposed, often makes them quite conspicuous. They frequently lie for hours in the warm sun on smooth, green hillsides, where they are readily seen from all points for miles around. However, their coat in summer is always decidedly brownish from earth stain, and one may easily overlook a large flock of them when they are on a hillside of light brownish limestone such as is characteristic of several localities in which I have found them. In winter, the color of the long, thick coat is snowy white and may afford them considerable protection from enemies, though just why other mountain sheep having practically identical surroundings are not also white is a mystery.

The white sheep formerly ranged over practically all the mountains of the interior of Alaska, and at present it is absent only from those mountains which lie near permanent settlements. It is abundant near the coast on the Kenai Peninsula and on the Arctic slope north of the Endicott Mountains, but elsewhere it is strictly confined to the peaks and ranges of the interior.

MOUNTAIN GOAT

A still more hardy mountaineer than the sheep is the white goat (*Oreamnos*) which inhabits the coastal mountains of Alaska from the Canadian boundary at Portland Canal northwest to the vicinity of Cook Inlet. Besides including the great glaciers, this region is one of extremely rugged mountains throughout, and though the scenery is magnificent, the climate, at least from the human standpoint, is not always all that could be desired. But the goats seem to prefer it to the sunnier ranges of the interior, to which they seldom stray. They live almost entirely at high altitudes, frequenting very steep cliffs and rock-walled canyons, and if a glacier affords passage from one part of their range to another, they unhesitatingly make it their highway.

To approach a mountain goat successfully is therefore quite as much a feat of mountaineering as of crafty hunting. In fact, it is more so, for the goat is rather stupid and keeps watch only over the country below him, so it is necessary to get above—and to get above a white goat is usually to attain the uttermost heights. But the lusty hunter who does so has few regrets, for the magnificent scenery is ample recompense for the physical exertion. Hunting the chamois in the Alps, now practically a thing of the past, scarcely could have offered such scenic surroundings as may now be had in the pursuit of the mountain goat in Alaska.

The flesh of the mountain goat, except in young animals, is strong and not especially palatable, while its hide has little commercial value. The additional fact that the animal cannot be obtained by lazy methods makes it very improbable that it will be extirpated in the near future. It has short, strong legs, a short neck and a thick, heavy body, withal presenting a clumsy appearance quite the reverse of what might be expected from the precarious nature of its habitat. The horns, which range 7 to 10 inches in length, are small, recurved, polished, and blackish. They are present in both sexes.

Many an old-timer in Alaska will tell the visitor that a species of ibex different from both sheep and goat inhabits the territory. When such stories are sincere they undoubtedly refer to young goats or to either the young or the female of the white sheep, for no true ibex is native to any part of North America.

DEER

In the north caribou are commonly called "deer," but there are no true American deer (*Odocoileus*) in Alaska except in the southeastern coast district from the vicinity of Sitka southward. Only one variety occurs, but this is exceedingly abundant, although the region inhabited by it lies well beyond the northern limits of any other American deer. It is a variety of the Columbia blacktail, from which it differs chiefly in smaller size and in having the upper side of the tail more extensively brownish. In size it is small, ordinary bucks weighing rather less than 100 pounds. It ranges from seacoast to timber-line in a region of forests and undergrowth rivaling those of the tropics in density and luxuriance.

One scarcely steps away from the beach within this region without encountering deer trails, and if one undertakes to follow any of them he is led through a veritable maze, now bending low to escape the wicked thorns of the "devil's club," now pushing through the yielding twigs of huckleberry bushes, again struggling among a tangle of the heavy-foliaged and matted sallal, or tolled on to future difficulties by the quick and easy progress afforded as the course leads along a hoof-worn furrow in the fallen trunk of a giant cedar. Under such circumstances, one knowing the general cunning of deer might suppose they would be very difficult to sight, but they occur in such abundance that in spite of much killing in the past they still may be found with no great effort. Until quite recently they were killed by thousands merely for their hides, which netted the hunter a few cents apiece.

But the present game law and rapidly improving local sentiment now promise to save them for the profit and enjoyment of future generations.

A BUSY DAY IN CAMP SKETCHING AND PREPARING MOOSE HEADS

BEARS

It is probably quite safe to say that Alaska is the home of more different kinds of bears than any other country of equal size in the world. No fewer than 13 kinds, as recognized by recent mammalogists, live in the Territory. The distinctions among some of these are based largely upon osteological characters apparent only to specialists, so to the ordinary observer the bears of Alaska resolve themselves into four groups—the brown bears, the grizzlies, the black bears, and the polar bears. Even this classification cannot be followed with certainty by amateurs, for although the extreme types are sufficiently distinct, some of the smaller varieties of the brown bears are easily confused with some of the larger ones of the grizzlies.*

The brown bears, typified by the huge species (*Ursus middendorffi*) of Kadiak Island, are the most interesting of Alaska's bears. They are of immense size, greatly exceeding the Rocky Mountain grizzlies and all other bears except the polar bear and their own relatives of the Siberian coast. Even the extinct cave bear is by no means a giant in comparison with them. They are confined almost exclusively to the coast region, ranging from Bering Sea throughout the Alaska Peninsula and some outlying islands, and thence south along the Pacific coast to the Alexander Archipelago. Their color varies greatly, ranging from dark seal brown to buffy brown, but although the ends of the hairs are often paler than the bases, the silver-tipped effect of the grizzlies is wanting.

NATURALIST RETURNING WITH ELEVEN CARIBOU SKULLS AND HORNS FOR AMERICAN MUSEUMS: GLACIER MOUNTAIN, NEAR EAGLE, ALASKA

* The confusion in the classification of the Alaska bears is due in part to lack of sufficient material for careful study. Hunters and residents of Alaska would confer a favor upon all naturalists and sportsmen if they would preserve bear skulls and send them to some large museum, preferably to the U. S. Biological Survey at Washington, which has, deposited in the U. S. National Museum, the finest collection of large bear skulls in the world.

Photo by C. Hart Merriam. From "The Harriman Alaska Expedition"

FUR-SEALS: SAINT PAUL ISLAND, BERING SEA (SEE PAGE 587)

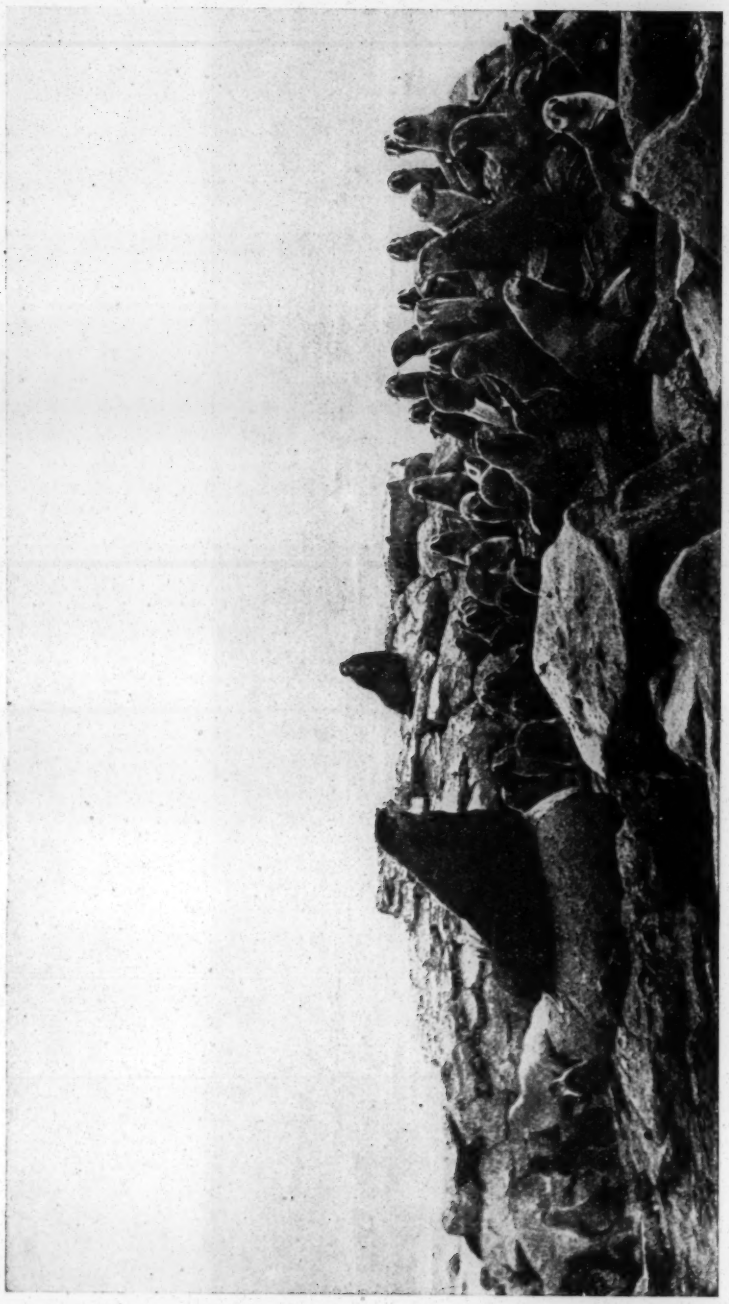
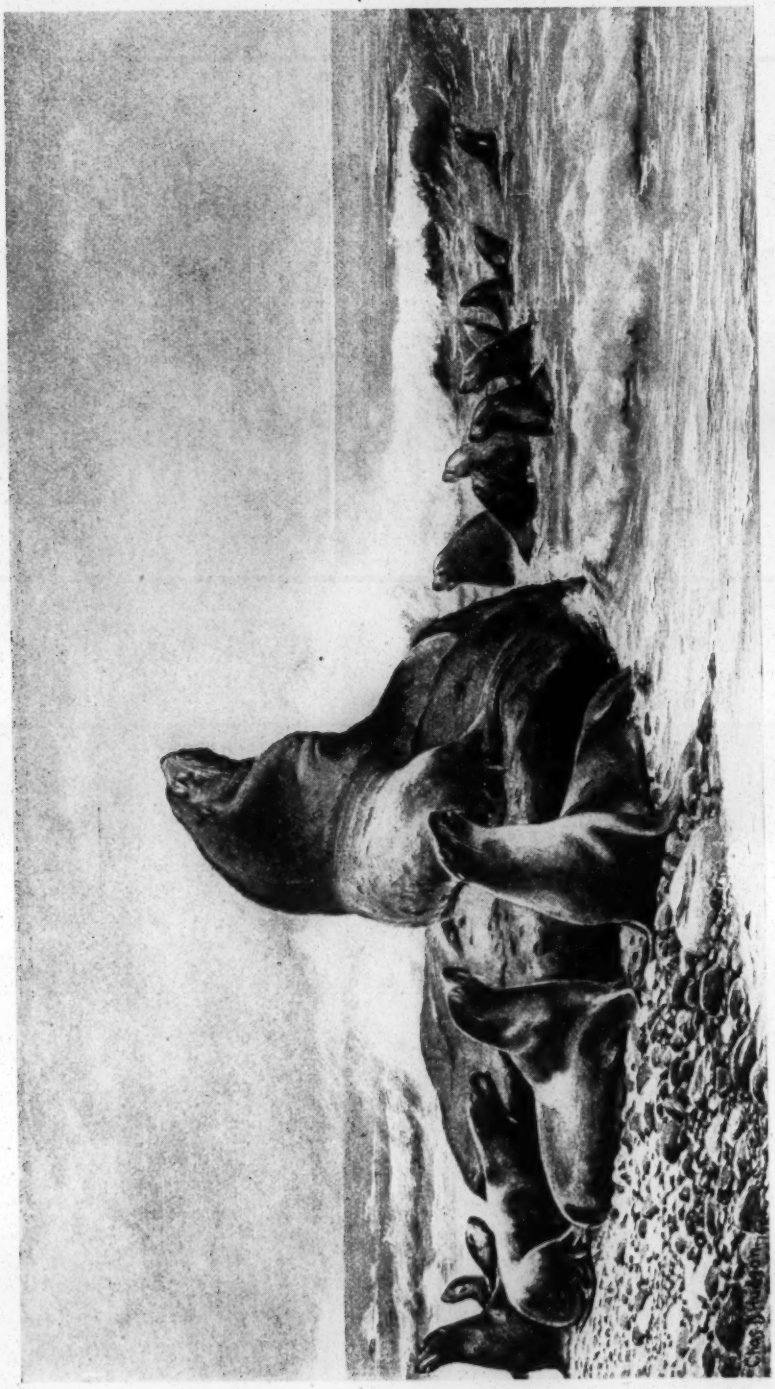


Photo by C. Hart Merriam. From "The Harriman Alaska Expedition"

HAREM OF FUR-SEALS: PRIBILOF ISLANDS, BERING SEA



Painting by Charles B. Hudson. Photo by C. Hart Merriam. From "The Harriman Alaska Expedition"

SEA-LIONS: PRIBILOF ISLANDS, BERING SEA

From a painting by Charles R. Knight. From "The Harriman Alaska Expedition"

KADIAK BEAR, URSUS MIDDENDORFI MERRIAM: KADIAK ISLAND, ALASKA

The front claws are thicker, shorter, and more abruptly curved than in grizzlies.

Owing to their great size, the brown bears are doubtless more powerful than the grizzlies, but they have the reputation of being more peaceable. As a rule, like other wild animals, they give man a wide berth, but in close quarters or under unusual circumstances they have been known to seriously injure or kill human beings. Like most other bears, these huge beasts avail themselves of everything the country affords in the way of food, including fish, flesh, fruit, roots, and grass—a variety of diet scarcely exceeded by that of the natives when under aboriginal conditions. On coming out from hibernation in the spring they eat young grass, herbage, and roots, and, if near the coast, a little kelp. Later they capture mice and ground squirrels, and when midsummer and the salmon come they make fishing their chief business. In the fall they fatten on berries.

The brown bears of Alaska will doubtless become very rare or extinct at no very distant date. Already they have become scarce on Kadiak Island, where formerly very abundant, and on the Alaska Peninsula, though still fairly numerous, they are being killed at a rate probably greatly in excess of their increase.

The grizzly bears of Alaska belong to at least two varieties, one (*Ursus horribilis phœonyx*) of the interior, the other (*Ursus kenaiensis*) of the Kenai Peninsula and adjacent coast region. Their habits are similar to those of the well-known grizzlies formerly so common in the western United States. In summer they are frequently found above and near timber-line, but they roam widely. At present they are perhaps most numerous in the Endicott Mountains and the Nutzotin and Alaskan Mountains, including the region of Mount McKinley.

Black bears are fairly common throughout all Alaska south and east of the treeless tundra. They are among the shyest of animals, and many doubtless slip away without allowing themselves to be seen. Thus in many districts where fairly common they are supposed to be scarce. The cinnamon variety is common in the interior, but rare or almost unknown on the coast.

Belonging with the black-bear group is the rare and interesting glacier bear (*Ursus emmonsi*), inhabiting the southern slopes of the Saint Elias Range and near-by mountains, at least from Cross Sound to the vicinity of Cape Saint Elias. It is supposed to live near the numerous glaciers of this region, but its habits are practically unknown and scarcely a dozen specimens, mostly imperfect, are contained in the museums of the world. The glacier bear is similar in size and general characters to the black bear, differing mainly in its color, which is silvery gray slightly mixed with black, the nose being brown and the feet blackish. In certain conditions of pelage the color has a somewhat slaty or bluish gray effect, from which the animal is sometimes called the "blue bear."

The well-known polar bear, which is no less common near the northern coast of Alaska than elsewhere in similar latitudes, completes the list of Alaska's bears. Owing to the remoteness of its habitat, it is seldom seen except by whaling or exploring parties. Almost emblematic of the territory under the false ideas at one time prevailing, this bear is now, in any consideration of Alaska's large animals, the one least to be thought of as characteristic of the country.

SOME GIANT FISHES OF THE SEAS

By Hugh M. Smith

U. S. Deputy Commissioner of Fisheries

BELIEF in the existence of sea serpents and other marine monsters goes back to a very remote antiquity and may be as old as man himself. That great Hebrew poem which we call the Book of Job has much to say about the "leviathan." This creature has been the subject of much speculation and may have been a myth, but there is nothing inherently improbable in its being a giant fish, and the following scriptural account might well have been written yesterday instead of three thousand years ago:

Canst thou draw out leviathan with a fish-hook?
Or press down his tongue with a cord?
Canst thou put a rope into his nose?
Or pierce his jaw through with a hook?
Shall the bands of fishermen make traffic of him?
Shall they part him among the merchants?
Canst thou fill his skin with barbed irons,
Or his head with fish-spears?
Lay thy hand upon him:
Remember the battle, and do so no more.

Who knows that primitive man may not have been coeval with some formidable marine creatures now extinct, the tradition of which has come down through the ages and left its impress on the mind of the present generation? The avidity and credulity with which the general public year after year receives newspaper accounts, which are purely fictitious or hang on slender threads of fact, portraying the capture or sighting of creatures of impossible form, show how firmly established and deep-seated is the conviction that the sea contains leviathans not yet known to science. Every season yields a fresh crop of sea-serpent stories and a new series of grotesque pictures of creatures which, if they really existed, would revolutionize our ideas of the animal kingdom. The writer has personally followed to their lairs two or three of the most horrible monsters conceived by the vivid imagination of the newspaper man, and found them to be well-known animals with little to suggest the sea serpent.

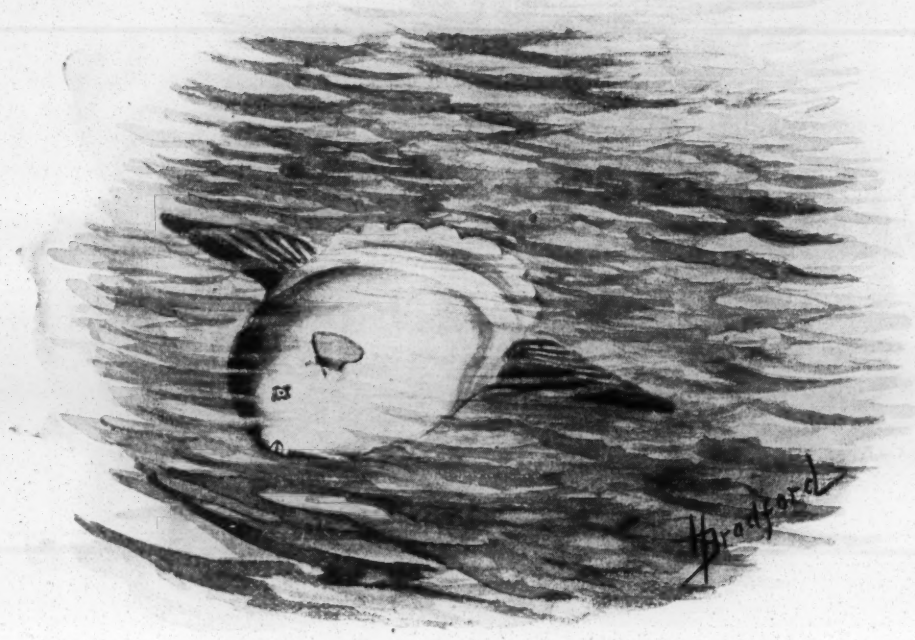
As to whether there really exist in the sea today strange monsters, scientists are not wholly in accord, although a negative view is held by most of them. The very circumstantial account of the sighting of a "sea serpent" on the Asiatic coast by the French gunboat *Decidée* a few years ago, as published in the journals at the time, will perhaps weaken the belief of some intelligent persons who have heretofore denied the possibility of the existence at this day of marine monsters comparable to those of geological times.

Whatever may be the truth as to the existence of such creatures, there are well-known members of the fish class which are so large that they deserve to be regarded as monsters, and may be the basis of some of the sea-serpent yarns with which the world has been regaled for centuries.

Among the serpentiform fishes there is none of such exceptionally large size as properly to belong in the sea-serpent class, although some deserve to be considered as giants among eels. If any known fishes may be suspected of aspiring to be sea serpents, surely they are the morays, although a sea serpent only 30 feet long would hardly satisfy present-day requirements, and no morays have yet been recorded which were half so long. They have, however, been known to exceed 10 feet in length, and they are among the most dreaded of fishes, having formidable teeth and showing a disposition to attack men.

THE SUN-FISH

A fish of such peculiar form that the Italians call it *mola*, a millstone, and the Spaniards *pez luna*, moon-fish, is known to Americans and English as the sun-fish,



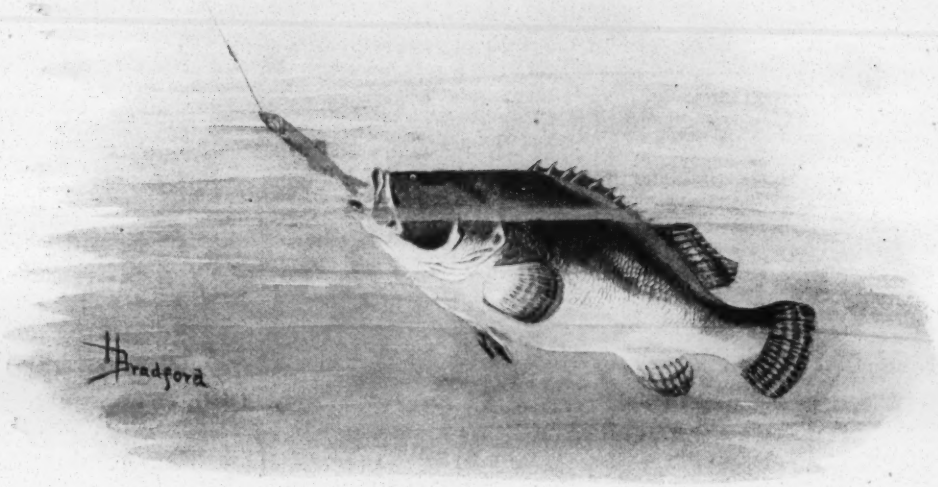
CHARACTERISTIC POSE OF AN OCEAN SUN-FISH

for it appears at the surface of the ocean on bright days and spends many hours basking listlessly in the sun, sometimes lying flat with one side just out of the water, sometimes with the back fin projecting like a buoy above the surface. It is disk-shaped, its height nearly equaling its length, and it has a long, narrow fin on its upper and lower edges posteriorly, and a short, broad flap representing the caudal fin; its eyes are large and its mouth small, and taken altogether it is one of the most grotesque of fishes, being apparently all head. Of almost world-wide distribution, it is particularly abundant on the southeastern coast of the United States and on the California coast. It swims but little, being usually content to be drifted along by the ocean currents. The Gulf Stream wafts many a sun-fish northward each summer, so that the species is not a rarity off southern New England, and I have seen a number of specimens that had become stranded on the coast of Norway. The fish is entirely harmless, and is so sluggish and listless, and is such a conspicuous object at sea, that it is easily approached and harpooned.

That the sun-fish deserves a place in the list of giant fishes may be judged from the fact that examples weighing 200 to 500 pounds are not rare, and that much larger ones are occasionally met with. The largest known specimen, harpooned in 1893 at Redondo Beach, California, weighed 1,800 pounds. On such a monster, lying on one side, there would be room for 30 men to stand. The strong teeth, shaped like a turtle's beak, suggest that hard-shelled animals constitute its food, but as far as known jelly-fish are its chief diet. The extremely tough, fibrous skin, several inches thick, and the general coarseness of structure seem inconsistent with such delicate food.

TUNNIES AND JEW-FISHES

The valuable mackerel family has one member which easily ranks first in size



A JEW-FISH ABOUT TO SEIZE A BAITED HOOK

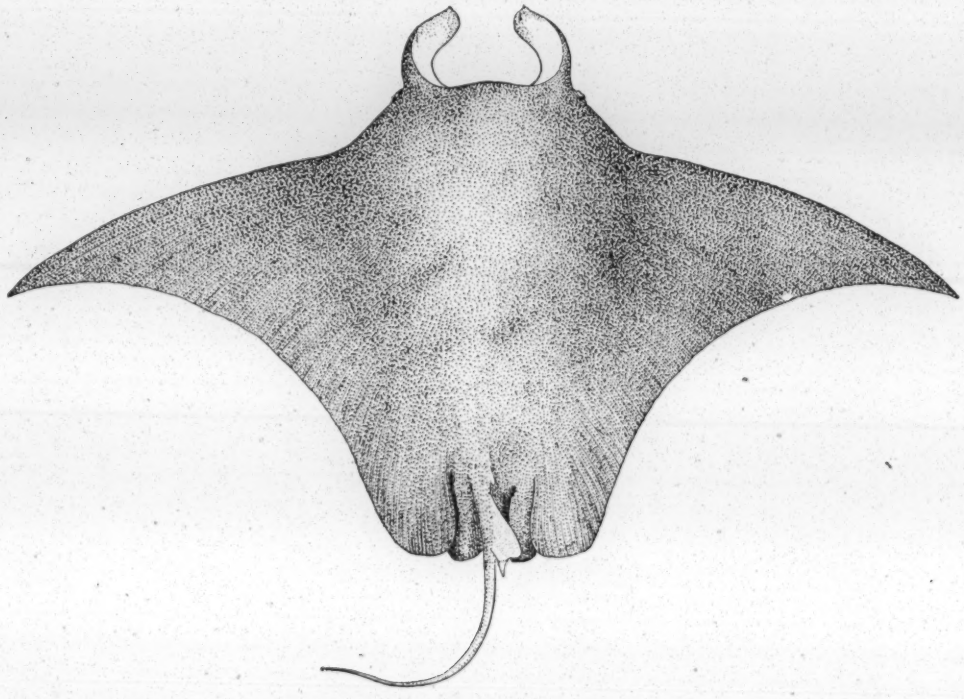
among the bony fishes, as distinguished from the sharks, rays, sturgeons, etc., with gristly skeletons. This is the horse mackerel or great tunny (*Thunnus thynnus*), whose range encircles the globe and which is an object of fisheries in many countries, notably southern Europe. Built on the compact and graceful lines of our common mackerel, it is the apothesis of speed, alertness, and vigor among the fishes of the high seas, and might very easily make a transoceanic trip in one-third the time of our fastest steamships. It preys on all kinds of small fish, and is often seen playing havoc among schools of luckless herring and menhaden. Fifteen feet is about its maximum length and 1,500 pounds its estimated maximum weight, although it is likely that this weight is considerably exceeded. Thirty tunnies harpooned by one fisherman during a single season weighed upwards of 30,000 pounds. A mutilated specimen 10 feet long was once found by the writer on the coast of southern Massachusetts; its head weighed 282 pounds and its carcass must have weighed fully 1,200 pounds when whole. In southern California, where this fish bears the Italian name of *tuna*, it is much sought by anglers, who use a 7 or 8 foot split bamboo rod and 600 or 700 feet of line baited with a flying-fish, and who have magnificent sport in landing small specimens weighing from 100 pounds upward, the record fish weighing 251 pounds and requiring four hours to kill.

Three species of fishes of the sea-bass family known as jew-fishes rank among the largest of the spiny-finned fishes. They inhabit tropical American waters, and range as far north as the California and South Atlantic coasts. The spotted jew-fish (*Promicrops itaiara*) is common in the West Indies, and reaches a weight of 600 pounds. The black jew-fish (*Garrupa nigrita*), found from South Carolina to Brazil, weighs 500 pounds. The California jew-fish (*Stereolepis gigas*), usually called sea bass, sometimes attains a weight of 600 pounds, and is one of the really great game fishes of the country, being much sought by anglers in southern California. An experienced angler has written, "My largest fish weighed 276 pounds, and I was repeatedly almost jerked overboard by the struggles of the bass. I have seen a 200-pound fish snap the largest shark line like a thread, and large specimens straighten out an iron shark hook; yet the skilled wielders of the rod catch these giants of the tribe

with a line that is not much larger than some eye-glass cords."

GIGANTIC "DEVIL-FISH"

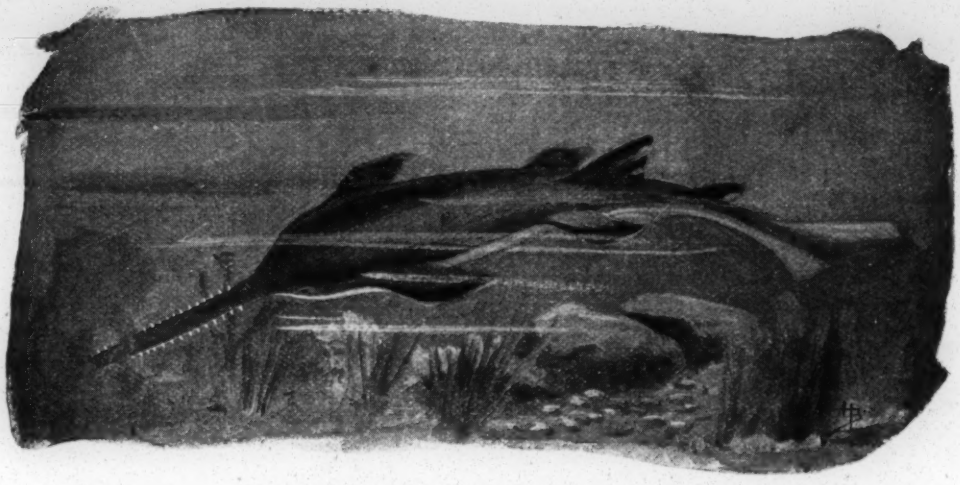
Among the rays are several members which reach colossal proportions. The largest and best known of these is the so-called "devil-fish" (*Manta vampyrus*) of our South Atlantic coast and the tropical waters of America, which occasionally strays as far as Cape May and is common south of Cape Hatteras. It is shaped like a butterfly or bat, and has been called the "ocean vampire." Projecting from either side of the head is a horn-like appendage, which in reality is a detached part of the pectoral fin or "wing." These horns, to which the name "devil-fish" owes its origin, are sometimes 3 feet long and are freely movable, being used for bringing food to the mouth. The mouth is peculiar in having no teeth in the upper jaw, while the lower jaw has about a hundred rows of small, paved teeth. Many years ago the pursuit of this fish was a favorite pastime of the Carolina planters, and William Elliott, in his "Carolina Sports by Land and Water," said: "Imagine a monster from 16 to 20 feet across the back, full 3 feet in depth, possessed of powerful yet flexible flaps or wings with which he drives himself furiously in the water or vaults high in the air." There are well-authenticated instances of this fish entangling its horns in the anchor ropes or chains of small vessels and towing them rapidly for long distances, to the mystification of the people on board. The pearl divers of the Caribbean Sea greatly dread this fish, and call it *manta*, meaning blanket, in the belief that it devours people after enveloping them in its enormous wings. The "devil-fish" is often seen lying quietly at the surface or slowly flapping its wings; at such times it is



A DEVIL-FISH: SPECIMENS OF THIS FISH WEIGHING TWO TONS AND MORE HAVE BEEN CAUGHT

easy to approach and harpoon it. It is only when attacked that the fish is dangerous, and then only by demolishing or overturning boats in its struggles.

The expanse of body in this species is greater than in any other known animal. Examples 16 feet wide are common, and those 20 feet across and over 4 feet thick are not rare. The maximum width is stated by authors to be 25 or 30 feet. One specimen, of which the writer had a photograph, caught in Lapaz Bay, Mexico, many years ago by the crew of the U. S. S. *Narragansett,* of which George Dewey was captain, was 17 feet wide and weighed nearly two tons. A fish of the largest size mentioned would weigh not less than six tons.



SAW-FISH OF THE SOUTHERN LAGOONS

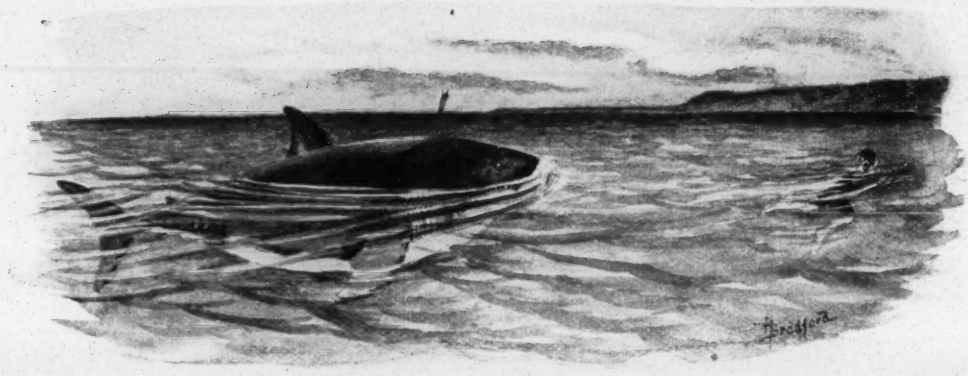
THE SAW-FISH

In the lagoons, sounds, and bayous of the West Indies and our southern coast there exists an abundant fish of great length, intermediate in structure between the sharks and the rays, and at once recognizable by the elongation of its snout into a wide, flat blade, in the edges of which are large, sharp teeth fitting in sockets and directed horizontally. The teeth are in 25 to 30 pairs, separated by wide intervals, and give to the saw-fish its name. The species is well known to those who reside in or visit the South Atlantic and Gulf seaboards, and the "saws" are familiar objects in curio stores all over the country. This fish has a broad, depressed body, and its greatest length exceeds 20 feet. The largest examples have saws 6 feet long and a foot wide at the base, with teeth several inches long. The saw-fish is without economic value and is never sought, but it has the faculty of getting entangled in the fishermen's nets and badly damaging them in its struggles to escape, so that the fishermen regard it as a nuisance and have to handle it with care in order to avoid the serious injury that might be inflicted by a lateral sweep of a big fish's saw.

MAN-EATING SHARKS 40 FEET LONG

When giant fishes are mentioned most people will at once think of the sharks, among which, indeed, are found the largest fishes now existing. Of the many species of sharks noteworthy on account of their size there are about half a dozen which are preëminent. These differ much in their disposition, some being as harmless as doves and others the incarnation of ferocity.

The sleeper shark (*Somniosus microcephalus*), whose scientific name fits it so admirably, appears to have developed its



MAN-EATER SHARK

body at the expense of its brain, for it is a sluggish, stupid glutton, about six times as long as an average man. At home in the Arctic regions, it sometimes makes visits as far south as Cape Cod, the British Isles, and Oregon. It is most often observed lying quietly on the surface, apparently dozing and easily approached, but at times, when hungry, it rouses itself and fiercely attacks whales, biting huge pieces out of their sides and tails, and when feeding on the carcass of a whale which has been killed by hunters it is so voracious that it permits spears and knives to be thrust into it without seeming to take any notice.

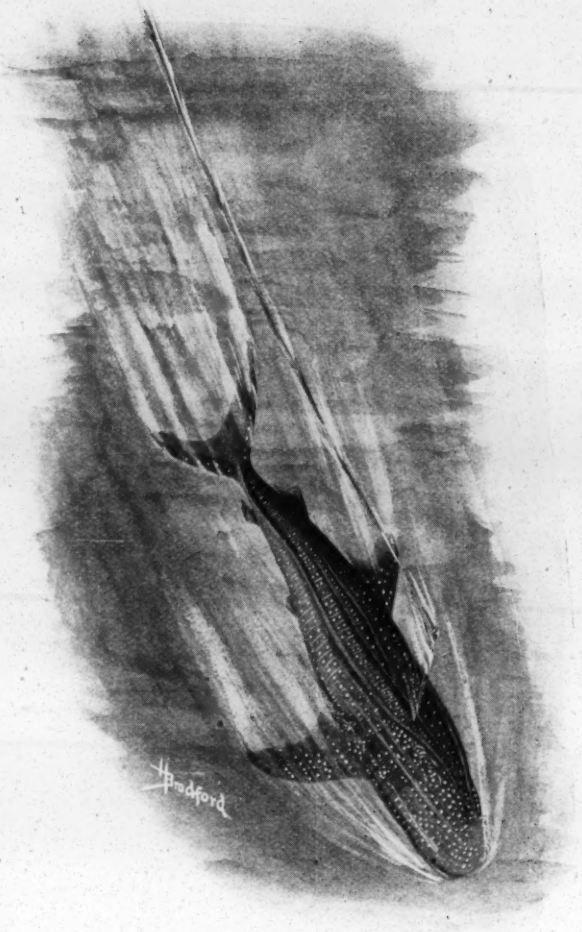
One of the most prodigious and perhaps the most formidable of sharks is the "man-eater" (*Carcharodon carcharias*). It roams through all temperate and tropical seas and everywhere is an object of dread. Its maximum length is 40 feet and its teeth are 3 inches long. While there are few authentic instances of sharks attacking human beings, there have undoubtedly been many cases where sharks simply swallowed people who had fallen overboard, just as they would swallow any other food. How easy it would be for a man-eater to devour a person whole may be judged from the finding of an entire hundred-pound sea-lion in the stomach of a 30-foot shark on the California coast. A certain man-eater 36½ feet long had jaws 20 inches wide, inside measure, and teeth 2½ inches long. This may have been the "great fish" of the scripture narrative, and it is possible that at that time much larger man-eaters existed than are now known, as shark teeth with cutting edges 5 inches long have been found on the sea-bottom, and these are believed by naturalists to have belonged to sharks not long dead. The phosphate beds of South Carolina yield very large fossil teeth of a shark which was related to the man-eater of the present day; judging from the comparative size of these teeth, Professor Goode thought that sharks 70 or 80 feet long must have been common.

THE "GREAT FISH" WHICH SWALLOWED JONAH

Many years ago a Norwegian bishop in a learned paper brought to the attention of the scientific and theological worlds a shark which he attempted to prove must have been the "great fish" that swallowed Jonah. This was the basking shark (*Cetorhinus maximus*), known also as the elephant or bone shark, which is an inhabitant of the polar seas, but occasionally strays as far south as Virginia and California, and in former years was not rare on the United States and British coasts. The species has the habit at times of collecting in schools at the surface and basking in the sun with its back partly out of the water. It reaches a maximum length of 50 feet and is exceeded in size by only three or

four animals extant. Provided with small teeth, it feeds on fishes and floating crustaceans, and is not of a ferocious disposition. It is dangerous only by virtue of its great bulk, and when attacked its powerful tail easily demolishes boats. In former years the basking shark was hunted for its oil on the coasts of Norway and Ireland; it was also harpooned on the shore of Massachusetts in the early part of the last century, and as many as 12 barrels of oil were sometimes obtained from the liver of one shark. There are many records of basking sharks 25 to 38 feet long from the coast of New York, Massachusetts, and Maine, but the species has not been common in our waters in recent years.

The largest of all fishes, the largest of all cold-blooded animals, and the largest of all existing animals, with the exception of a few species of whales, is the whale shark (*Rhincodon typicus*), originally described from Cape of Good Hope, but now known from India, Japan, South America, Panama, California, and various other places, a small specimen having been obtained on the Florida coast a few years ago. This shark has a very broad and obtuse snout and an exceedingly wide mouth armed with numerous minute teeth; the dark-colored body is marked with many small whitish spots. The species is stated to attain a length of 70 feet and is known to exceed 50 feet. Notwithstanding its immense size, however, it is harmless to man unless attacked, and feeds on the small creatures for which its teeth are adapted. Its huge bulk makes it dangerous in the same way that a whale is dangerous. Years ago it was reported that the sperm-whale fishermen at the island of Saint Denis, in the Indian Ocean, dreaded to harpoon a whale shark by mistake, and stories are told of how a harpooned fish, "having by a lightning-like dive exhausted the supply of rope which had been accidentally fastened to the boat, dived deeper still, and so pulled a pirogue and crew to the bottom."



PLUNGE OF A HARPOONED WHALE SHARK

RIBBON-FISHES

The ribbon-fishes constitute a group chiefly noteworthy for their shape and the circumstances under which they have been met with, although some of them are among the most elongate of fishes. Imagine a creature one foot high, three or four inches thick, and more than 20 feet long, with the consistency of a wet towel, and you will have some idea of a

ribbon-fish. What would otherwise be only a plain band is ornamented with most delicate fin-tufts on head, tail, and body. Dr Günther remarked that "some writers have supposed from the great length and narrow shape of these fishes that they have been mistaken for 'sea serpents,' but as these monsters of the sea are always represented by those who have had the good fortune of meeting with them as remarkably active, it is not likely that harmless ribbon-fishes, which are either dying or dead, have been the objects described as 'sea serpents.'" On the other hand, Goode and Bean, in their Oceanic Ichthyology, say that "it seems quite safe to assign to this group all the so-called 'sea serpents' which have been described as swimming rapidly near the surface with a horse-like head raised above the water, surmounted by a mane-like crest of red or brown."

One of the most interesting of the ribbon-fishes is the oar-fish (*Regalecus glesne*), of which a number of examples have been found on the coast of Europe but only a few on the shores of North America. The common name refers to the blade-like expansion at the end of each ventral fin. Specimens have been known to reach a length of 20 feet, and much larger ones undoubtedly exist. One that went ashore in Bermuda in 1860 was 17 feet long after capture, but was thought to be much larger by the people who saw it in the water, and was described as having "a head of an immense horse with a flaming red mane." This species was not recorded from America until February, 1905, when a mutilated fish was found at Anclote Keys, on the west coast of Florida.

It is a matter of considerable interest that a second specimen should have been taken in February, 1909, at Captiva, Lee County, Florida. It was not quite dead when picked up, and exhibited the beautiful coloring for which these fishes are noted. The body was bright silvery, rivaling the tarpons, while a continuous fin of blood-red hue extended from head to tail, and on the head were a number of scarlet hair-like streamers. According to Mr F. E. Brockway, of Beach Haven, Pa., who found the fish and has communicated this information to the NATIONAL GEOGRAPHIC MAGAZINE, this example was 10 feet 8 inches long and 3½ inches thick.

Our knowledge of these fishes is due to no activity on the part of zoölogists in finding their habitat and collecting them therein, but to the circumstance that when they die or lose their equilibrium they fall upward and float on the surface, whence they are picked up or drift ashore. Nearly all the specimens known have been found dead or dying, and few, if any, have been secured in deep-sea collecting apparatus. This suggests how fragmentary must be our knowledge of the larger animals of the oceanic abyss and how possible it might be for unknown monsters to exist there in abundance. The appliances employed for securing animals from the depths are adapted only for the capture of comparatively small creatures lying on or within a few feet of the bottom and of so sluggish a disposition that they permit a net very slowly scraped along the bottom to scoop them up. If a net having a mouth ten feet wide and two feet high were slowly drawn for short distances and without selection of locality along the surface of the earth by a rope attached to an airship floating one to two miles high, how many bears, deer, lions, boa constrictors, alligators, to say nothing of elephants, giraffes, and rhinoceroses, would likely be caught and hauled up to the ship, even if the net were drawn during the darkest nights?

OUR PACIFIC NORTHWEST

By N. H. Darton, U. S. Geological Survey

VISITORS to the great Alaska-Yukon-Pacific Exposition in Seattle this summer will be greatly impressed by the wonderful diversity of features and products presented by Washington and Oregon. They will find plains and prairies, high mountains and wide valleys, arid lands and regions well watered by nature. The desert plains and ridges are treeless, while in the great forests of the western slopes are some of the largest woodlands and finest timber in the country. The two states constitute a somewhat isolated province. On the east are the high mountains of the northern Cordillera, and on the south is the high, rough, thinly populated district of northern California. On the north is the Canadian wilderness, and on the west the Pacific with a wild, rough coast broken by but few harbors.

Twenty-five years ago this province had but a meager population. Now it is occupied by about 1,600,000 persons, and the number is increasing more rapidly than in any other large section of the United States.

One of the most important reasons for this rapid increase in population is the fact that a large amount of valuable land is purchasable at low prices. There are now practically no more free "homesteads" available in most parts of the West on which a settler can make a *bona fide* home and a living. Much land can be purchased in the great Middle West, but it rarely is suited for high-priced agricultural products, and the region is now overcrowded with stock and sheep. The rapid growth of the Northwest country is well illustrated in Yakima County, where the population is 45,000, yet one of the first settlers is now an active business man but little past middle life.

Washington and Oregon are separated into two strongly contrasted physiographic provinces by the long, high range of the Cascade Mountains, which extends from north to south across their western portion. To the west is a zone plentifully supplied with rain by the moist air from the ocean, while to the east is a great irregular basin with low or moderate precipitation. These features are shown on the rainfall map on page 647. In this map it will be seen that the southeastern portion of Oregon is a desert region, while on the immediate ocean coast the rainfall is over 70 inches, and in places the amount is 100 inches a year. The contrast is strongly expressed in the vegetation; there is a dense forest with heavy undergrowth extending from the Cascade summit west, while to the east are wide areas of treeless plains or ridges with open pine woods.

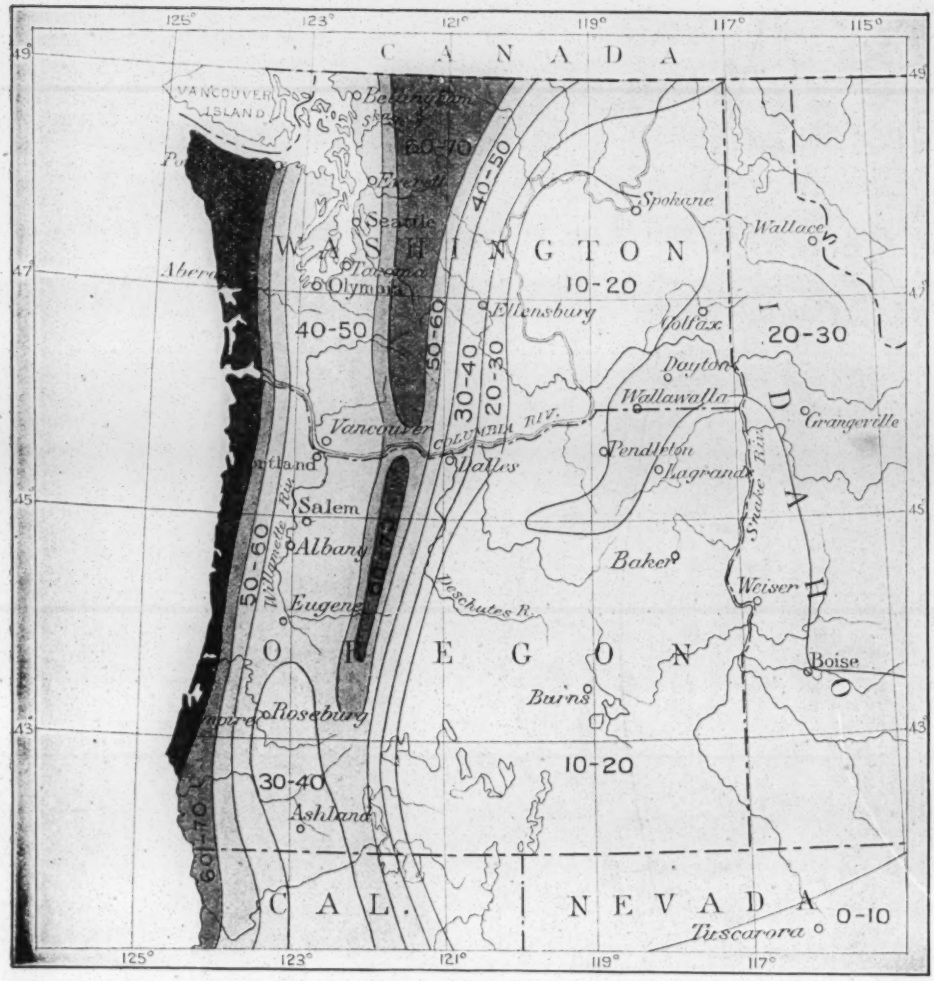
WEALTH IS INCREASING RAPIDLY

Five great continental railroads reach the Pacific in Oregon and Washington and handle a vast volume of freight. The great ocean to the west is the outlet to many foreign markets, and the steamship trade, rapidly increasing in volume, now carries abroad nearly $90,000,000 worth of freight from the larger ports of the Pacific Northwest. All kinds of industries are developing rapidly, some of them supplying all local demands and others shipping widely to other parts of this country and abroad. The invested capital is rapidly growing on the profits which it is gaining, and as much of it is local, the region is becoming independent of Eastern financial aid. Owing to this fact, there is diminishing danger of serious disturbance by the depressions which are felt every few years in other portions of the Union.

It is claimed that climatic conditions aid the prosperity of the far Northwest, for the moderate temperatures are highly favorable to labor, and undoubtedly a pleasant climate attracts population. There is surely a great contrast between one's feelings on an average summer day

OUTLINE MAP OF WASHINGTON AND OREGON

in Portland or Seattle and in Saint Louis or Chicago. One of the most significant indications of the progress of a region is the extension of railroads into it, for the far-sighted builders of railroads usually make careful estimates of the business to be expected. There is more activity in this respect in the Northwest than in any other part of the country, both in extension of old systems and the building of new roads. One of the most notable events in this direction was the completion in 1908 of the new line down the north bank of Columbia River, which affords a continuous down-grade route jointly for the Northern Pacific and Great Northern roads. It cost $10,000,000, but is a most important artery. The



RAINFALL MAP OF WASHINGTON AND OREGON

completion of the Chicago, Milwaukee and Saint Paul Railroad into Tacoma and Seattle marks another most important stage in transcontinental trunk-line communication.

PUGET SOUND

The ocean commerce finds its principal outlets from Puget Sound and Columbia River.

Puget Sound is one of the most remarkable water bodies in the world. It carries tidewater inland from the Pacific Ocean for 200 miles, with channels so deep from the Straits of Fuca to many of its head branches as to accommodate the largest vessels. The shore-line is so irregular that its length is about 1,500 miles, and there are numerous branching bays which afford safe harbor and great water fronts for wharfs. It is free from reefs or shoals, and the straits are wide open to the ocean, without bar or other obstructions to delay entrance or require pilotage.

It is an interesting fact that the Straits of Fuca are 800 feet deep at their mouth and 200 feet at the narrows to the east. These straits and Puget Sound are an old valley system excavated by streams

when the land was high and now flooded by tidewater, owing to a general subsidence of the coast region. Most of the Alaska trade comes into Puget Sound, and it is claimed that this harbor is today nearer most Oriental ports than San Francisco. On its shores are the large cities of Seattle, with a population of 260,000; Tacoma, 100,000; Bellingham, 35,000; Everett, 25,000; Olympia, the capital of Washington, and many smaller places.

Columbia River is a wide watercourse for many miles above its mouth, but its depth is very much less than that of Puget Sound. The bar at its mouth has only 24 feet of water at mean low tide, and there are still shallower stretches on the route to Portland. However, the river is easily navigable for very large ocean vessels, which carry a heavy tonnage of imports and exports. Certain improvements now in progress by the government will deepen the water at the mouth of the river, and it is expected that Congress eventually will make provision for the excavation of a 30-foot channel all the way to Portland.

The Alaska-Yukon-Pacific Exposition at Seattle, prepared at a cost of $10,000,000, sets forth in glowing colors the great resources of the Northwest. It is not an anniversary, but simply an exposition, and while Alaska will be the special feature, Washington and Oregon will have much prominence and doubtless gain greatly by it.

SEATTLE

The Pacific Northwest has three great cities—Seattle, Portland, and Tacoma—all on tidewater near the west coast. Portland, the oldest, commands the Columbia River commerce, and Seattle and Tacoma are on the splendid harbor of Puget Sound. No large city in the world can boast of such rapid growth as Seattle has had in the last few years. According to data obtained by U. S. Geological Survey, in 1908 there were 7,901 permits issued, representing $13,777,329 for labor and materials. This is seventh in rank, or higher than Pittsburg or Boston. San Francisco at the same time issued 6,729 permits, with the high value of $31,668,341, but this was due largely to replacing the expensive down-town buildings destroyed by the fire.

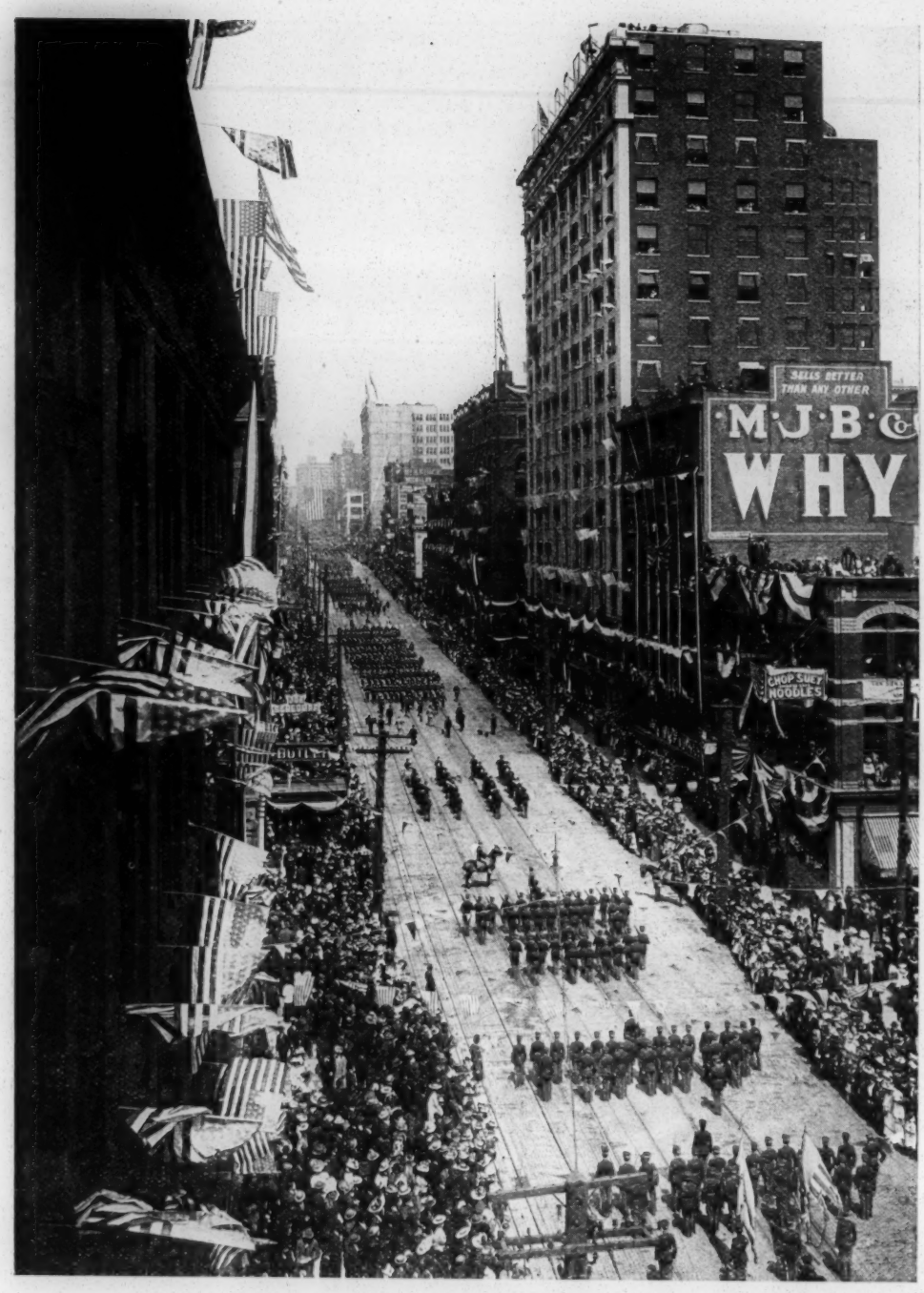
At the beginning of this year the population of Seattle was estimated at 260,000. When it is remembered that in 1880 the number was only 3,533, the gain is phenomenal. The city covers an area of 78 square miles, two-thirds land and one-third water; it has 413 miles of graded streets, 215 miles of sewers, 375 miles of water-mains, and 20 peaks with an aggregate area of 415 acres. Its factories have a $15,000,000 pay-roll, and their product is valued at $60,000,000. The exports in 1908 were $18,138,596 and the imports $12,961,094, besides a large coast trade, especially with Alaska. The bank clearings amounted to $429,499,251 in 1908.

Contrary to the idea which many people have, the rainfall of Seattle is considerably less than that of Washington, New York, or Boston, but as much of it comes in the rainy season of early winter, that part of the year is not altogether attractive.

The death rate is one of the lowest of large cities in the world. Much of the Seattle area is hilly, but the city has climbed the larger hills and leveled extensive districts, so the old prediction of rival cities, that the hills would restrict her progress, has been verified. Extensive swamp areas have been reclaimed, in part with material removed from the hills.

PORTLAND

Portland, with a population approaching a quarter of a million, controls the greater part of the lower Columbia trade. The city is beautifully built on broad terraces of moderate height on Willamette River, a short distance above its mouth. It has deep water to its extensive dock system, and its ocean commerce averages about $12,000,000 a year. New York is the greatest wheat-shipping port in the world and Portland is second. Its exports for the year ending June 30, 1908,



SECOND AVENUE, SEATTLE

This view of the leading business thoroughfare was taken on May 26, 1908, during the parade of the men from the Atlantic battleship fleet then in the harbor. Copyright by Asabel Curtis.

OLYMPIC MOUNTAINS, FROM SEATTLE

Looking westward across Puget Sound at the Olympic Mountains, which rise on the Olympic Peninsula lying between the Sound and the Pacific Ocean. This view includes the area recently set aside by the government as the Olympic National Park

were 13,411,581 bushels of wheat and 858,845 barrels of flour. Its manufactures are varied and extensive, but lumber leads, one great mill cutting one-half billion feet a year, worth over $9,000,000. Flour is a close second.

Several trunk railroads come into Portland, exchanging a great tonnage of freight of many kinds, which is rapidly increasing in amount. One great advantage that Portland has in freight is the down-grade haul down Columbia River. When Celilo locks are completed the river will be open for navigation all the way to the great wheat country to the east. If the government deepens the channel of the Columbia River to 30 feet, the larger ocean vessels can be accommodated and Portland's foreign commerce will be considerably increased in amount. The present limit of draft is 25½ feet.

Portland, and the Willamette Valley extending south, has a particularly equable climate, with average temperature of about 54°. In winter the daily variation in temperature is often only 5° to 10°. The mean annual precipitation is 41¼ inches, but much of it is in the rainy season, which begins late in the year. Green grass all the year round indicates the mildness of the winter climate, and there is no extreme heat in summer. Portland well merits her title of the Rose City, for roses abound throughout her resident section from April to Christmas. It has the low death rate of 9½ per 1,000 a year.

TACOMA

Tacoma is third in size of the cities in the Pacific Northwest, but it is full of enterprise and its rapid development sustains its more sanguine promoters in the expectation that it will finally become the dominating metropolis. It has some notable advantages. Primarily it lies nearer than Seattle to the great agricultural districts, so that the land haul to tidewater is less, especially by the new railroad line down the north branch of Columbia River.

The population is now about 105,000, yet thirty years ago it was only about 1,000. The death rate is remarkably low, only 8 per 1,000. The topography is favorable for growth, and the harbor facilities are all that could be desired. It has an ocean commerce of about $45,000,000 a year, about half of which is export trade. Its wheat shipments in 1908 amounted to 11,500,000 bushels of wheat and 800,000 barrels of flour, with an aggregate value of $13,500,000. It has extensive lumber business, having the largest saw-mill in the world. Its pay-roll in manufacturing plants in 1908 was $8,760,000, paid to 11,800 persons for an output valued at $43,677,418. Its building record for 1907 and 1908 was slightly over $4,000,000 for each year.

The climate of Tacoma is not materially different from that of Portland and Seattle. The mean annual temperature is 51.4° and the mean annual rainfall 45.4 inches. Most of the precipitation is in the rainy season, in the winter. Tacoma believes that her topography will greatly favor her growth. The city is built along the slope and over the top of a fine, wide plateau 300 to 350 feet high, extending far to the north, west, and south. The adjoining lands to the east are partly swamp and partly the flat bottom valley of Puyallup River, which offer very large areas to be reclaimed for docks and railroad yards. It is expected that long basins will be excavated in the reclaimed lands, so that 70 miles of dock-line may be developed, or more than the water front of New York city.

In the interior portions of Washington and Oregon there are many flourishing cities, notably Walla Walla, North Yakima, Wenatchee, Ellenburg, and Pendleton, with scores of smaller towns, which cannot be described in a brief article.

FAMED FOR THEIR APPLES

Oregon and Washington are more widely famed for their apples than for any other product. They are produced in large quantity, kept to a high standard by careful selection, and shipped to all parts of the world. London and other European markets receive many of them, and they bring fancy prices wherever

sold. The trees generally bear large numbers of perfect fruit of beautiful color, fine texture, and excellent flavor.

Hood River Valley, Oregon, is one of the most famous apple localities, but there are many others in both states. The fine apples usually sell for $2 to $3 per box of 50 pounds, or about a bushel, the price depending on variety and quality. Some range higher, and a record sale of Newtown pippins in London, in 1905, reached $5.43 a box. The market for them is always active, because the demand is far greater than the supply.

Many readers will be surprised to know that the total apple production of the United States has decreased from 60,540,000 bushels in 1895 to 25,000,000 in 1907. In 1908 Oregon produced 1,310,000 boxes of apples, valued at $1,215,000, and the total fruit crop was valued at $3,256,000. The value of the fruit crop of Washington is estimated at $19,000,000.

Extraordinary profits are reported from many apple orchards in the Northwest, $500 an acre a year being not unusual. With all other northern fruits the results are similar. The cherries raised in Salem, Oregon, and elsewhere are shipped far and wide. At many places they yield a profit of $500 an acre. Prunes are a great crop, and in the vicinity of Vancouver alone there are a half million producing trees. Oregon's prune crop of 1907 sold for $1,590,625. Strawberries are raised with great profit and shipped to Salt Lake, Denver, and as far east as the Mississippi Valley. They frequently are so large that 20 will fill a quart box, and they possess fine flavor and texture. Other small fruits give heavy crops and high profits.

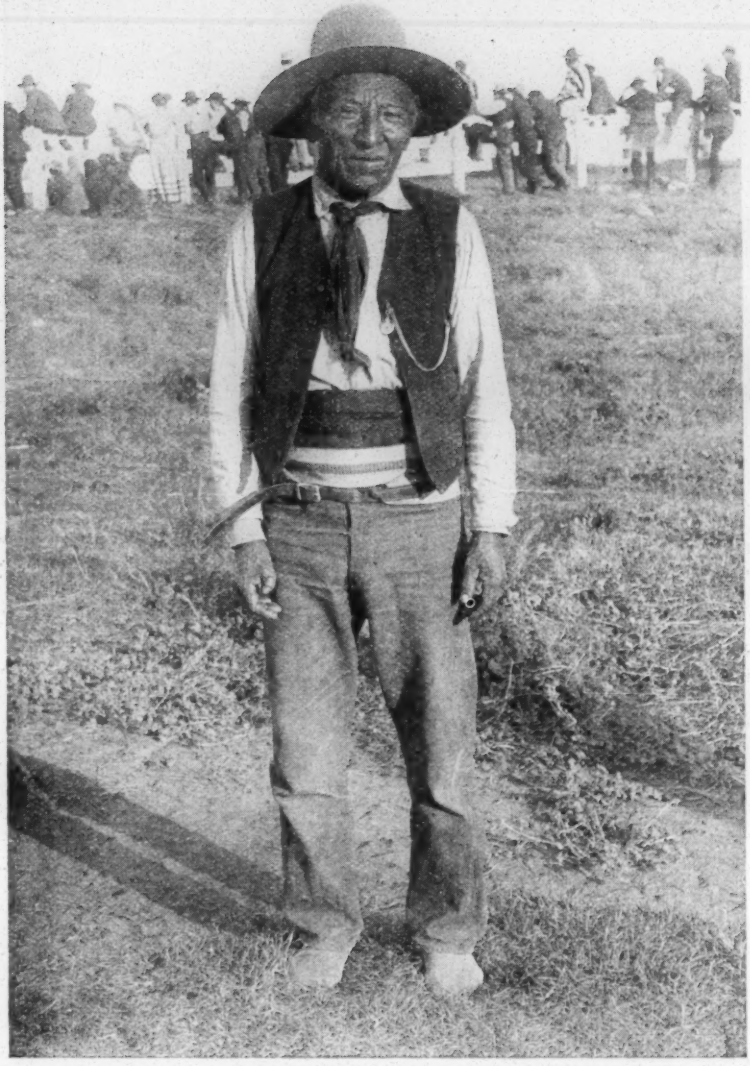
Almonds are now being produced in various places, notably in Klickitat County, southern Washington, where they yield from 1,200 to 1,500 pounds to the acre. The shelled nuts sell for 10 to 15 cents a pound. Walnuts have also an encouraging future, for they yield large returns. There is an active market for nuts in this country, for we import over 20,000,000 pounds a year.

MILLIONS OF BUSHELS OF WHEAT

The eastern half of Washington and a large part of northeastern Oregon is one of the greatest wheat regions in the world. Thousands of square miles of rolling plains formerly thought to be suitable only for cattle-ranging have proven to be most favorable for wheat. Crops of from 20 to 40 bushels an acre are obtained. In 1907 Washington produced 40,000,000 bushels and Oregon 18,500,000 bushels, and the area under cultivation is still on the increase.

Oregon is the leading hop-growing section of America, Salem being the great center of the industry. In 1907 the crop was approximately 24,000,000 pounds, or nearly half the entire crop of the United States. The selling price averaged only 10 cents a pound, but even at this low figure there was profit for Oregon, which is not the case in some other regions where the yield is lighter. Western and middle Oregon have the proper climatic conditions, and the yield is from 1,200 to 1,800 pounds to the acre, 1,500 pounds being frequently obtained. It requires 25,000 people to gather the crop and they are paid about $700,000 for their services.

While the region west of the Cascade Mountains has plenty of rainfall, the country east requires more or less irrigation. One of the greatest contrasts is that presented by the great desert plains before and after irrigation. Usually this contrast may be seen most impressively along the main ditches. On the one hand is the wide expanse of arid plains sparsely covered by sage brush and scattered blades of bunch grass. Below the ditches, where water is applied, are cultivated fields with splendid growth of alfalfa or grains, fine orchards yielding superior fruits of various kinds. These products support a prosperous population with fine farm-houses and bustling villages. Often the water is brought many miles from the mountains, but it is not expensive, considering the value of the products which it enables the farmer to raise. There are many private irrigation



YAKIMA INDIAN, ONE OF THE OWNERS OF LARGE AREAS OF IRRIGABLE LAND ON THE YAKIMA RESERVATION

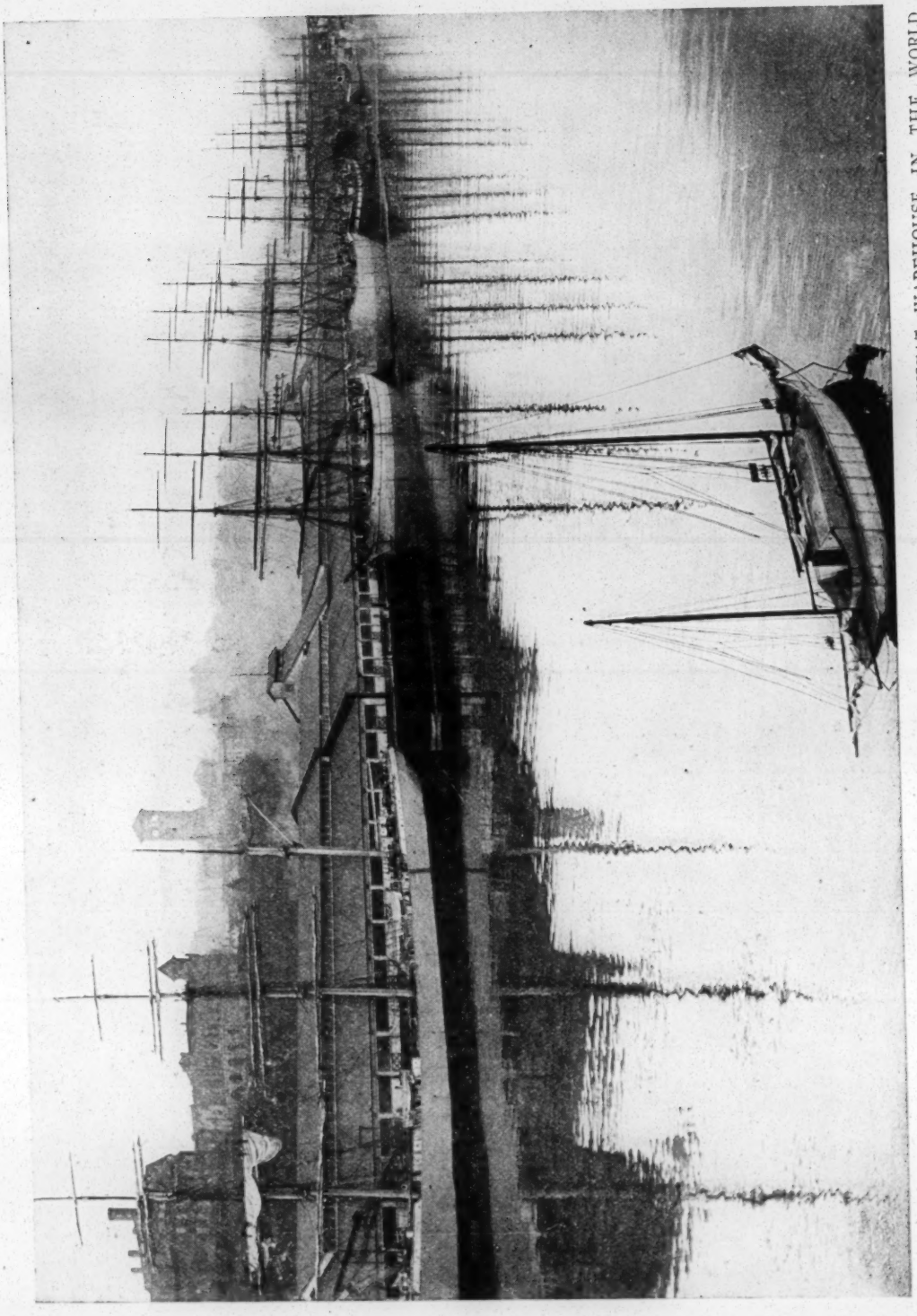
canals, some corporate and others mutual, and the U. S. Reclamation Service has in progress three great irrigation projects which will provide for the irrigation of a vast acreage of arid and semi-arid land.*

* See "The Call of the West," by C. J. Blanchard, NAT. GEOG. MAG., May, 1909.

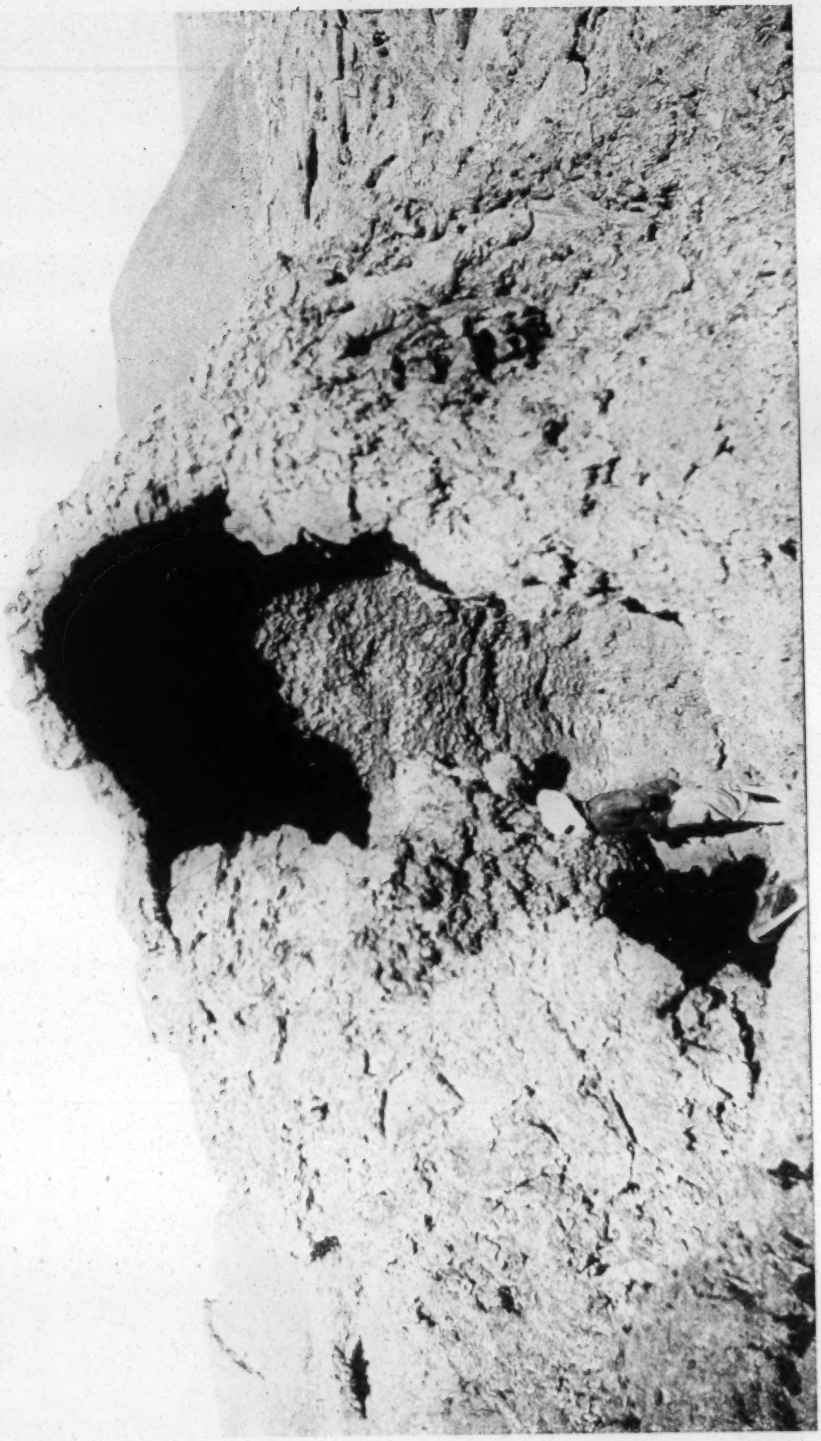
OUR GREATEST FORESTS ARE IN OREGON AND WASHINGTON

The greatest forests remaining in the United States extend west from the crest of the Cascade ranges to the ocean. They have been deeply invaded by the lumberman, but vast tracts of virgin

THE GATEWAY TO TACOMA, SHOWING NORTHERN PACIFIC RAILWAY YARDS AND ONE OF TACOMA'S LONG WHEAT WAREHOUSES: MOUNT RAINIER IN THE DISTANCE



VIEW OF TACOMA'S HARBOR, SHOWING SHIPS LOADING GRAIN AT THE LONGEST WHEAT WAREHOUSE IN THE WORLD



A BUBBLE OF LAVA ON ONE OF THE GREAT RECENT FLOWS OF EASTERN OREGON

forest remain. Much of the timber is of great size and of high quality. The government estimates for Oregon are about 213 billion feet of lumber, and for Washington about 195 billions. It is conservatively valued at $12 a thousand. The lumber business in Washington is about 4 billion feet a year, selling at $60,000,000, and Oregon has about half of this amount. Washington claims first rank in the lumber business, with 100,000 people engaged in its various branches on an annual pay-roll of $7,000,000. In cedar shingles alone she produces to the value of $15,000,000 a year.

The larger part of the forest growth is the splendid Douglas fir (spruce) which is illustrated on page 659. Large amounts of red cedar, spruce, and hemlock are also found. In the mountains east of the Cascades there is much yellow pine, which adds greatly to the lumber resources. The so-called fir is one of the most valuable woods known for structural work, having greater tensile strength than oak. Many trees exceed 200 feet in height, and usually they are free from flaws or irregularities of growth.

ABUNDANCE OF WATER POWER

Many of the streams of the far Northwest have large volume and great fall, thus presenting most favorable conditions for utilization for power. The Secretary of State of Washington has made an estimate for the larger rivers of 3,000,000 horse-power which can be made available by ordinary means, and the Oregon Conservation Committee estimates the total undeveloped water power in Oregon at 3,317,000 horse-power. These are large figures. Many of the streams mentioned will furnish from 100,000 to 400,000 horse-power. Some of the force is now being utilized, notably part of that of Snoqualmie Falls, which now furnishes Seattle and Tacoma with remarkably cheap power, carried 40 miles on wires. The plant is said to be the second largest in the United States; it cost $10,000,000.

The falls of the Willamette at Oregon City, a short distance above Portland, were harnessed long ago; they supply a large amount of power for local mills and half of the electricity for 115 miles of street-car lines in Portland. Rogue River and many other streams are also being used. Lake Chelan is a great natural reservoir. Fifty miles long and at an elevation 300 feet higher than Columbia River, it is capable of furnishing a large amount of power, only a small part of which is now being utilized. Water power in the region east of Tacoma will soon be harnessed, to add greatly to that city's supply of electricity.

Another valuable asset of the watercourses of the Pacific Northwest is the abundance of fish. The fisheries that are scattered over the two states are a source of great revenue. Columbia River is famous as the favorite resort of the superb salmon known as the Royal Chinook, which weighs from 60 to 70 pounds, and there are several other varieties.

On the lower part of the river the fish are caught in nets, but higher up revolving wheels are used, which often scoop up thousands of fish in a day. The salmon catch varies greatly from year to year, depending on the runs, but its value a year is about $3,000,000.

The extensive open range and the mild winters are especially favorable to stock of all kinds. Oregon stands sixth in the United States in its sheep and wool production. There are in that state about 3,500,000 sheep. A short time ago Oregon's wool production reached 22,000,000 pounds a year. Some of this from Willamette Valley sold for 30 cents a pound; in that section, moreover, the yield is often 15 pounds to the sheep. In eastern Oregon the yield is 6 to 9 pounds. This industry is also on the rapid increase in the state of Washington.

NOT RICH IN GOLD AND SILVER

The Pacific Northwest appears not to be as well endowed with the precious metals as California, Nevada, and the Rocky Mountain province. Washington is low in metal production, but has many promising prospects, especially of low-grade ores, which will eventually be worked with profit. The southwestern portion of Oregon has had profitable gold mines and placer workings ever since the

discovery of the first nugget, in 1851; the total output from that field has been at least $35,000,000. The placers are worked to the limit of the present water supply, but water storage will greatly increase the yield. Some of the washings produce from $6,000 to $50,000 every year, working only during the wet season; in general the ground runs from 10 to 30 cents a yard. A water power already developed on Rogue River by a 20-foot concrete dam at Gold Ray affords 10,000 horse-power, mostly utilized for mining in that district. In the Blue Mountains of eastern Oregon are many gold mines, mostly of small or moderate size, but with fair aggregate production, the total of which amounts to about $100,000,000. Near Baker City 450 stamp mills are in operation, with 2 to 20 stamps each. Oregon's total gold product for 1907 was $2,855,700.

Extensive deposits of copper ore are known in Oregon, notably in the lower end of Josephine County, and in various localities in central Washington. Coal is being mined in Kittitas, Pierce, and King counties, Washington. A group of mines in the western part of Kittitas County gives employment to 2,000 men and produces about 2,000,000 tons a year. The Coos Bay district, Oregon, has an annual production of 70,000 tons. Many other coal prospects are awaiting development.

Considerable platinum has been obtained in Oregon. Molybdenum is mined in central Washington, and mercury ores have been discovered at several localities in southwestern Oregon. Some of the dried-up lake basins in eastern Oregon contain extensive deposits of borax and soda, now beginning to be utilized.

The local demand for building materials on the Northwest coast can be judged from the fact that the cost of building in 1908, in Seattle, was $13,577,700, and in Portland, $9,446,982. There were 1,294,800 barrels of cement (valued at $3,884,400) used in Portland, Seattle, and Tacoma in 1907, of which about two-thirds was imported. Building stones, such as granite, marble, and sandstone, are available in large amount, but they are not extensively developed. Limestone suitable for the manufacture of cement occurs in certain sections and one large plant is now in operation on Skagit River, Washington. Cheap lumber has been an important factor in the rapid growth of the towns, but large amounts of stone, brick, concrete, iron, and terra cotta are also used in the cities.

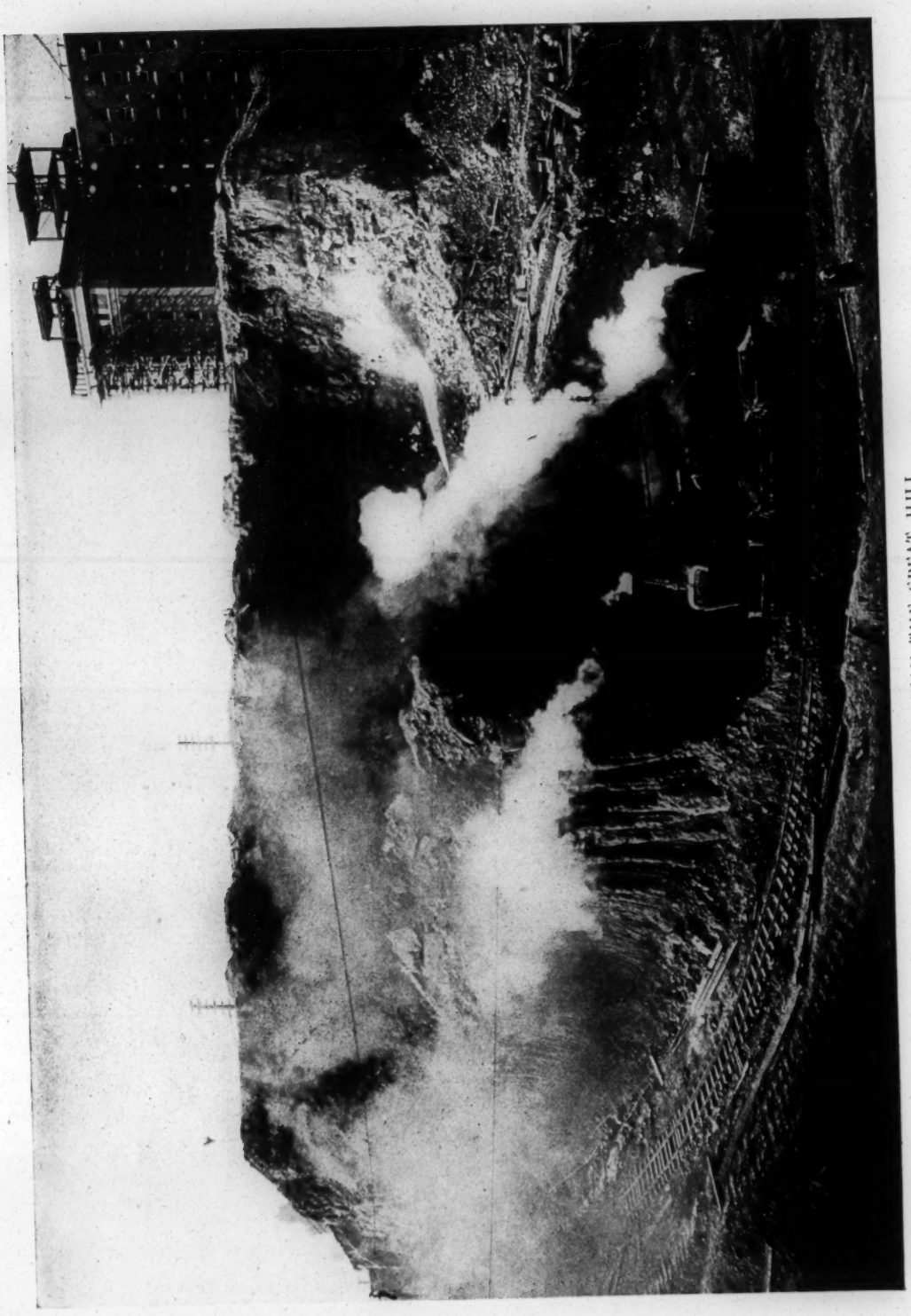
MAGNIFICENT SCENERY

The Pacific Northwest presents many features of notable scenic beauty. Probably the most admired are the great conical peaks of Mounts Rainier, Baker, Adams, Hood, Helens, and Jefferson, which are plainly visible from the coast. They are all volcanic and rise far above the surrounding lands into the realm of perpetual snow and ice. Some of these peaks are shown in views in this article, but photographs do scant justice to their beauty. Mount Rainier is often mentioned as the highest mountain in the United States, but its altitude is only 14,363 feet, or inferior to many other peaks in this country. It bears extensive glaciers, and these occur also on the higher of the peaks above mentioned. Some notable glaciers lie on Glacier Peak, in central Washington. Rugged, high mountain scenery is presented by the Cascade and other ranges of the region, some of which may be seen from the railroads.

The scenery of the great gorge of Columbia River is especially fine, with its cliffs of volcanic rocks over 1,000 feet high, over which are numerous waterfalls. Much of the land stretching away on either side of the gorge is an undulating upland, a fact which would hardly be suspected by persons traveling up the river. Lake Chelan, a most remarkable body of water, occupies a long, narrow gorge of the mountains of central Washington. It is 50 miles long and from 1 to 4 miles wide, with its water level about 300 feet above Columbia River. Much of the bold coast of Washington and Oregon is highly picturesque and the Puget Sound region is full of notable features, especially the great pile of the snow-clad Olympic Mountains lying between the sound and the ocean.

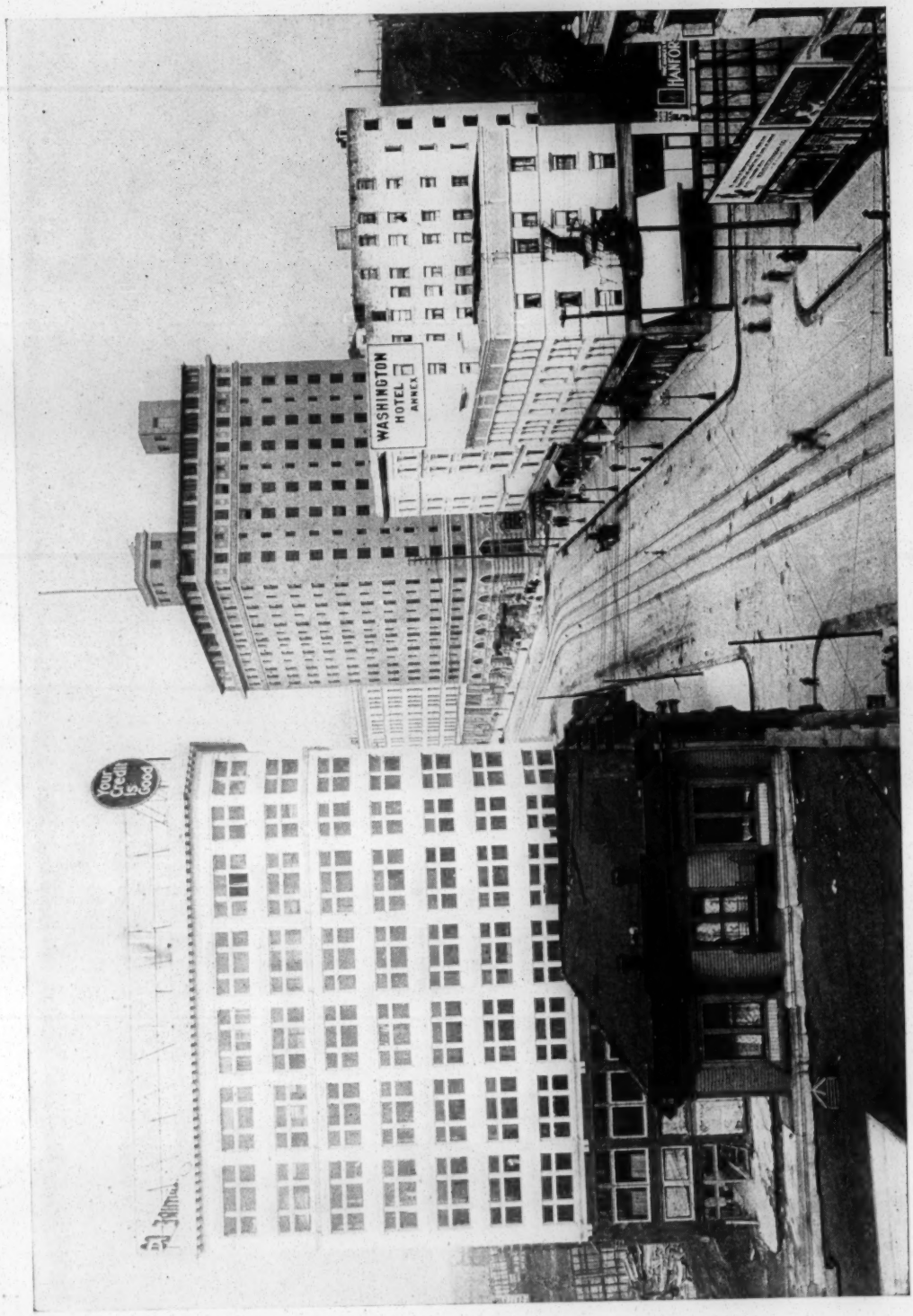
THE DOUGLAS FIR, THE PRINCIPAL TIMBER OF THE PACIFIC NORTHWEST COAST
(SEE PAGE 657)

This and the succeeding three pictures show what is being done in Seattle in the way of removing hills for the expanding business district. These regrading projects involve the removal of more dirt than any other modern enterprise outside of the Panama Canal. The total depth of the excavation, from the foundation of the Old Washington Hotel, shown in this view, to the foundation of the New Washington, was 108 feet.



WASHING AWAY THE GREAT HILL

THE LAST OF THE OLD HOTEL WASHINGTON



THE NEW HOTEL WASHINGTON

THE TALLEST TREE THAT GROWS

By Edgerton R. Young

IN these days, when the reforesting of the waste lands of our country is becoming a question of such national importance, the study of the relative value of different species of trees is naturally very essential.

Scientific parties are scouring the earth in search for new plants, fruits, and vegetables to add to our enjoyment and happiness. A good degree of success has already attended their efforts, and doubtless much more will yet be accomplished by them.

Owing to the rapidly increased price of timber and lumber, the matter of forest-growing is of vital interest to the great corporations like the railroads, manufacturing and building companies, that must have, for their very existence, vast quantities of timber and lumber. The timber required by the railroads for the one item of railroad ties, not taking into consideration the quantity used in the construction of cars and buildings, consumes the output of many hundreds of thousands of acres of timber lands every year.

While undoubtedly the valuable trees indigenous to America will be most largely replanted and utilized, many others that are not natives of this continent, when found by experiment to be easily grown and of value, will also be imported and largely cultivated.

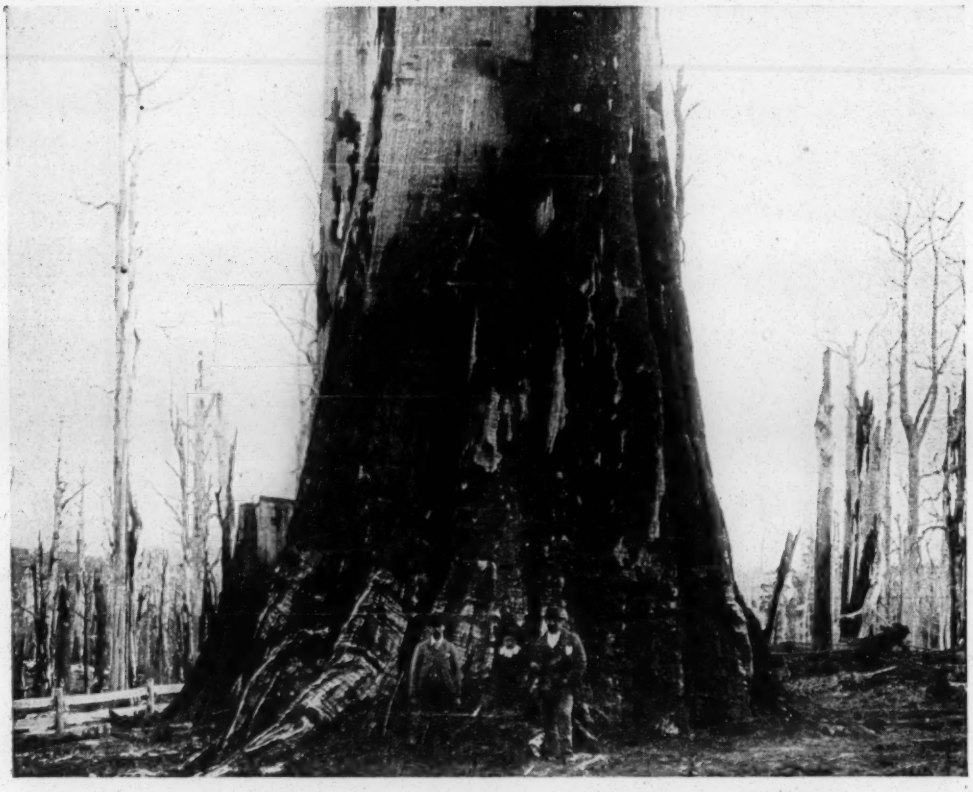
In the case of the eucalyptus this has already been done, and so extensively is the tree now grown in California, and so many and valued are its uses, that it will be news to multitudes to hear that there still live many who remember when it was first brought into that state by the late Bishop Taylor from distant Australia, its original home.

It was a surprise, as well as a revelation, to find on our recent visit to Australia that in that far-away land, under the Southern Cross, were growing trees that towered in the air 150 feet higher than the great Sequoia, the famous red wood of our American West; and yet such is the fact, as some specimens of the *Eucalyptus amygdalina* reach to the great height of 480 feet. Specimens abound that are from 120 to 200 feet in circumference. The one partly shown on page 665 is 76 feet around several feet from the ground. It is, as are all the larger ones, practically of no use for commercial purposes, as the expense of cutting down such enormous trees and then getting their logs split up into pieces that can be handled is so great that these monsters are passed by the thrifty lumbermen for the smaller ones that are more easily handled.

The *Eucalyptus amygdalina* is the tallest, if not perhaps the largest, tree that grows. Specimens over 400 feet high are frequently found, while some have been measured towering up to 470 and 480 feet. The timber of these great specimens is easily worked, and, as it does not warp readily, is much used in carpentry.

On page 666 we see the method adopted by the skilled lumbermen of Australia in felling the eucalyptus trees that are not too large for their purposes. The bottom of the eucalyptus is generally so gnarled and twisted that the men construct a rough, but safe, platform, averaging from 12 to 20 feet from the ground. Here, with their great long-handled axes and saws, they work and toil until the giant tree, that perhaps for over a thousand years has lifted up its head in that land of almost perpetual sunshine, is laid low.

From the illustration on page 667 we can form some idea of the magnitude of one of these giant eucalyptus trees. In a great cavernous opening in its side was sufficient room for a commodious kitchen, with all of its appliances, for the accommodation of Lord Hopetown, Governor General of Australia, and his suite,



A EUCALYPTUS 76 FEET IN CIRCUMFERENCE (SEE PAGE 664)

during one of his visits to one of the regions where these gigantic trees abound in the State of Victoria.

The eucalyptus tree is a genus of trees and shrubs of the natural order of *Myrtacea,* embracing about 150 species. All but four of them are natives of Australia and Tasmania only. The eucalyptus trees are so abundant in many parts of Australia that over vast areas they are practically the only trees visible. The fact that the fully developed trees are destitute of symmetry and beauty robs the great Australian wooded regions of that attractiveness and charm which gives such pleasure and delight to the primeval forests of America.

One striking characteristic of several varieties of the eucalyptus is that, while they never seem to shed their leaves, they cast or slough off their bark in long strips every year. The leaves, which have a leathery appearance, contain a considerable quantity of volatile oil. The tincture or oil extracted from them has a bitter aromatic taste and is extensively used as a remedy for various diseases.

On the young shoots of many species the leaves in pairs are opposite to each other, as they appear on ordinary plants, while on the older branches the leaves are arranged alternately and grow in such a way that they present their edges to the sun. This seems to be nature's provision to protect them from the intense heat of the tropical sun of those lands where they most flourish.

The *Eucalyptus globulus,* generally called the blue gum, from its bluish-green leaves, is the variety most successfully grown in California. It has also been introduced and flourishes in India,

A EUCALYPTUS FOREST IN AUSTRALIA

Natal, Egypt, Algeria, and in various parts of southern Europe and in some other warm countries. It cannot stand the frost, and so must be classed among tropical trees. Perhaps only in the states of Florida and California can we expect to see it in perfection in this country; yet although its introduction into California has been of but recent date, already its value to that state has been very considerable. Its growth here has been so rapid that trees of 80 feet in height and over a foot in diameter have developed from the small planting of a dozen years. Its rapid growth makes it a valuable acquisition to those lands where in so many instances there was such a great lack of forest trees of general utility. In California its timber is being extensively used for telegraph poles, railroad ties, for fencing purposes, and in the manufacture of some kinds of furniture.

Some of the species of eucalyptus are much more valuable than others. There is also a great diversity both in their appearance and worth. One of the most valuable is the *Eucalyptus marginata*, popularly called the Jarrah wood. It grows to a great size and its timber is so hard that it is found to be especially valuable in the construction of wharves, as it resists the attack of the ship worms and borers that are so destructive to ordinary wood. Because of this quality it also enters largely into the construction of ships and is utilized in other marine uses.

Some varieties of the eucalyptus yield a kind of astringent gum or resin called Vino, while from others a species of manna—a hard, little, sweet substance—is obtained in considerable quantities. As an antidote against malaria and as being valuable in warding off or dissipating malaria in regions where malaria abounds, the eucalyptus has obtained a considerable reputation. Expert opinions seem to be divided as to the way in

ONE SIDE OF A EUCALYPTUS TRUNK USED AS A KITCHEN: AUSTRALIA (SEE PAGE 664)

which its beneficent results come about. Some think it is the result of the volatile oils which these trees give off through their leaves, acting as a neutralizing and even destructive power against the malarial matter in the atmosphere; others maintain that its beneficent results are caused by the fact of the trees being such rapid growers, and the great quantity of water they thus absorb and then give off purifies the atmosphere. Whatever may be the cause, the fact is evident that their presence in goodly numbers, planted in malarial regions, has produced most beneficent results.

The Roman Campagna especially has been greatly benefited, so much so that large portions once considered almost fatal to human life, and shunned and feared, are now the abodes of numbers of people who find, since the introduction of the eucalyptus trees, but little traces of the dreaded malaria that for ages once caused those regions to be so shunned and deserted.

In the low malarial regions around the Cape of Good Hope and in some similar unhealthful regions around Algiers and elsewhere, the same beneficent results have followed the introduction of the eucalyptus trees.

As yet no variety has been discovered that is able to withstand even a moderate frost, but the fact that millions of these trees can be raised so easily and quickly in California and Florida and perhaps in the warm places on the Gulf of Mexico, and that its timber can be so widely utilized, is a matter for congratulation to all who are interested in the conservation of our forests and also in the introduction of new varieties of trees that will add to the timber wealth of the country.

NOTES ON THE EUCALYPTUS TREE FROM THE U. S. FOREST SERVICE

MORE than 100 species of the eucalyptus tree have been introduced into the United States. They are, however, adapted to a subtropical climate, and only a limited portion of this country is favorable for their growth. The possibility of growing eucalyptus in any region is determined by the amount of cold that the young trees have to endure. Few of the species can survive a temperature below 20° F., and none of them a temperature of less than 12°.

In general, eucalyptus may be successfully planted in the sections of the United States suitable for the culture of citrus fruits. They are grown in nearly all the agricultural sections of California, along the coast of southern Oregon, and to a limited extent in Arizona, New Mexico, and western Texas. Several species have also been planted in Florida and along the Gulf coast. Here, however, occasional frosts have killed or severely damaged the trees, and for this reason planting has been discouraged.

The blue gum (*Eucalyptus globulus*) has a phenomenally rapid rate of growth. Seedling stands will average a height growth of 50 feet in 6 years and 100 feet in 10 years. Under very favorable conditions individual trees have reached a height of 125 feet and a diameter of 36 inches in 9 years. In sprout stands growth is even more rapid; trees frequently reach 3 inches in diameter and 35 feet in height in 8 months, while in 3 years a diameter of 7 inches and a height of 70 feet are often attained. In California, under favorable conditions, trees have attained a height of 175 feet and a diameter of 5 feet in 25 years. Although sometimes irregular in form, the tree tends to develop a straight, gradually tapering, unforked stem. In plantations the trunks become rapidly cleared of branches to a considerable height, but in the open, trees branch more widely and gradually develop a short crown of massive, spreading branches.

Blue gum is practically immune from disease. Where trees are reproduced by sprouts, the old stumps frequently decay slowly at the heart, while the sprouts remain unaffected. Growing trees are not attacked by insect enemies, but felled timber lying unbarked upon the ground is subject to injury by a wood-mining insect.

Blue gum rarely suffers any breakage of the limbs from winds, and the spreading root system renders the trees very wind-firm.

Fire is the greatest source of injury to eucalyptus plantations. Both the natural characteristics of the trees and the conditions within planted groves render them peculiarly susceptible to fire injury. The large quantity of litter—dry leaves, branches, and shredded bark—which accumulates beneath a stand is extremely inflammable. The bark of eucalyptus is so thin that the trees are injured even by light surface fires.

The wood of blue gum is very heavy, hard, strong, and tough, but it is not durable in contact with the soil. It is close-grained, and is split with difficulty after it has dried. It is less elastic than hickory, but it has been demonstrated by mechanical tests that seasoned blue gum timber is very little inferior in strength and stiffness to the best second-growth hickory. In appearance it closely resembles the wood of hickory and ash.

Blue-gum timber is utilized for a great variety of purposes in California. The wood is excellent for fuel, and in the treeless valleys has been the chief fuel supply for many years. In southern California the steady demand renders commercial planting for fuel very profitable. Eucalyptus timber has been extensively used in California for wharf piling. Blue-gum piles are in use in nearly every port on the California coast, and extended trial has shown that they resist the attacks of marine borers which destroy timber in sea water longer than other species commonly used for piling. Blue-gum timber has also been used to some extent for fence posts and telephone poles. The wood is not suitable for this purpose, however, on account of its short life in the ground. Seasoned posts last a little longer than green posts,

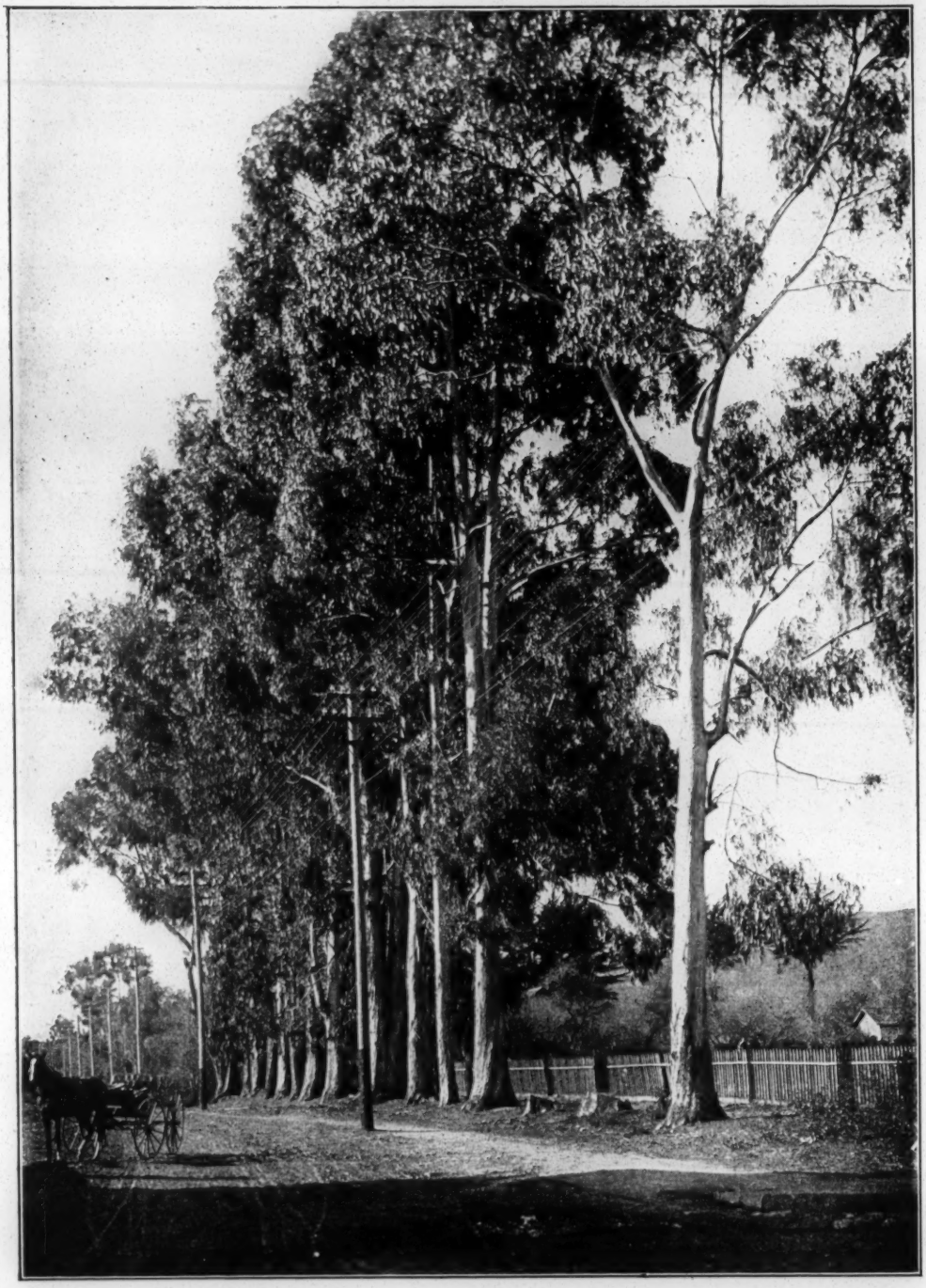


Photo from U. S. Forest Service

EUCALYPTUS GLOBULUS (THE BLUE GUM): SANTA BARBARA, CALIFORNIA

A row of trees 31 years old, ranging in diameter from 3 to over 5 feet. They were among the first planted in southern California

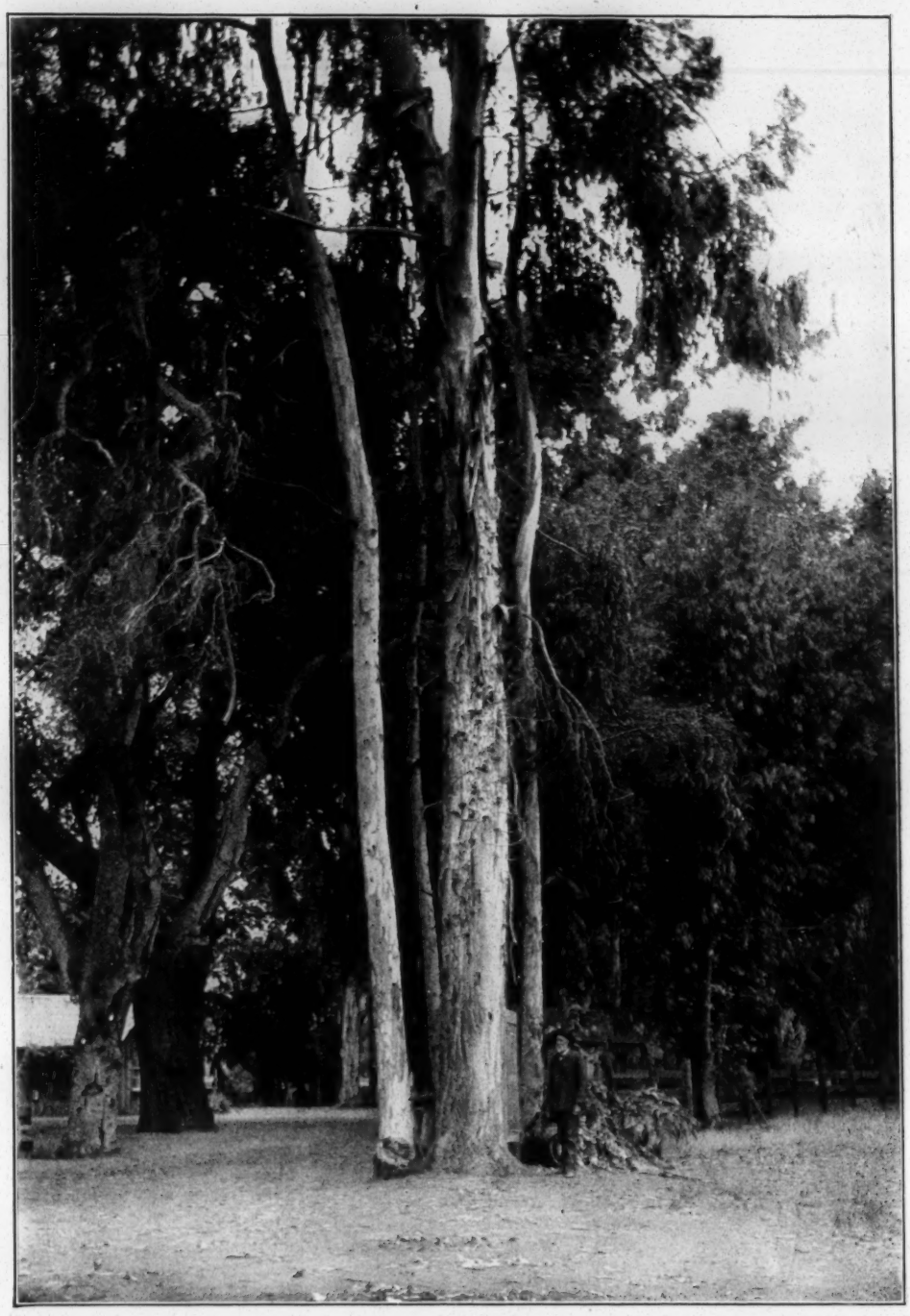


Photo from U. S. Forest Service

EUCALYPTUS GLOBULUS ON RANCH OF ELLWOOD COOPER, SANTA BARBARA, CALIFORNIA

Trees 24 years old. The largest eucalypt has attained in 24 years the diameter that the oaks have in over 200 years

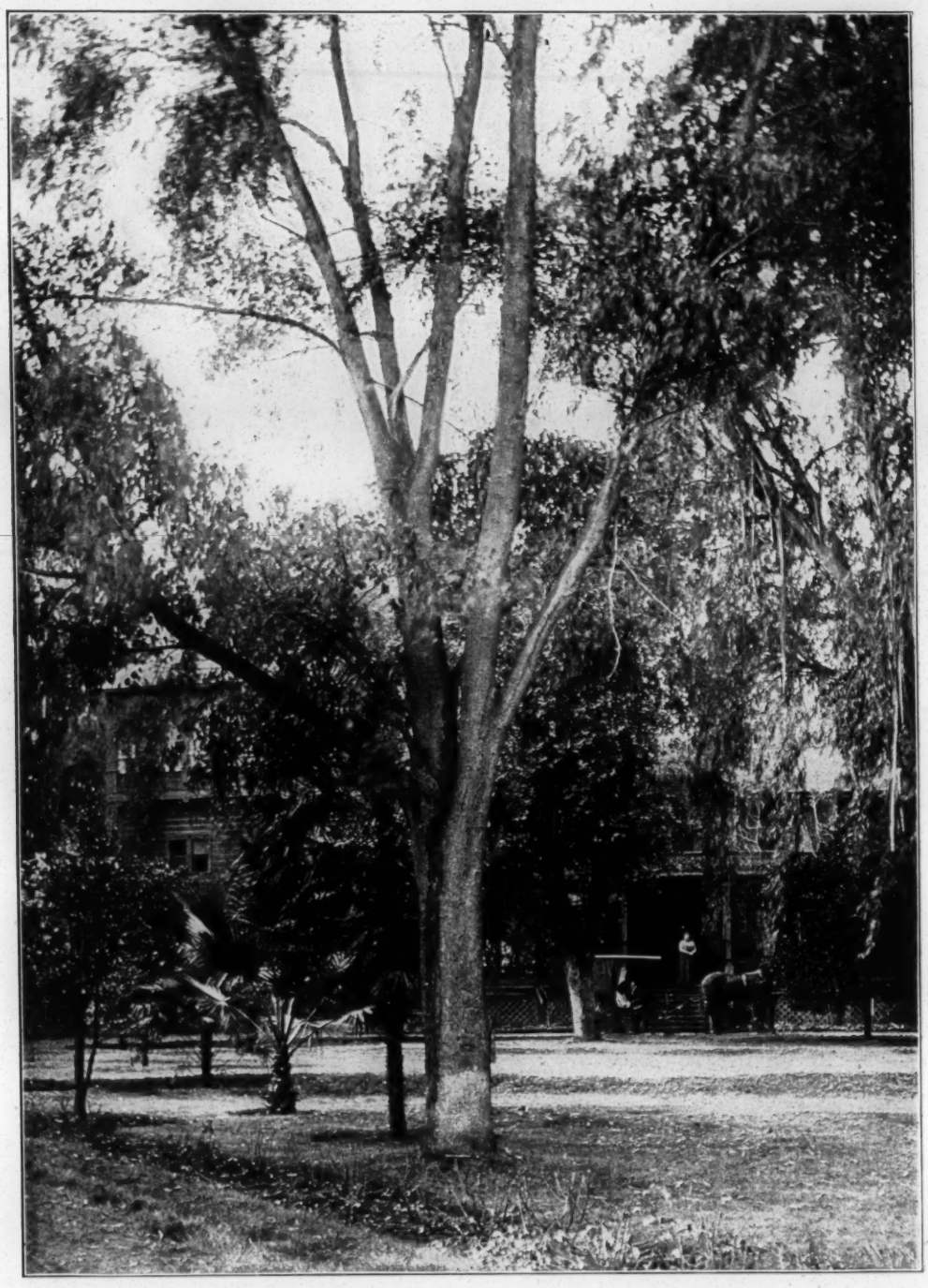


Photo from U. S. Forest Service

EUCALYPTUS RUDIS ON GROUNDS OF MINNEWAWA RANCH, FRESNO, CALIFORNIA

Tree 12 years old; diameter of trunk, 2 feet. This species endures more heat and severer frosts than any tree in the Southwest

Photo from U. S. Forest Service

EUCALYPTUS VIMINALIS: PASADENA, CALIFORNIA

Tree 24 years old; diameter of trunk, over 5 feet

and timber cut from the heart is more durable than sapwood.

Blue-gum timber has been used to a limited extent to determine its value for railroad ties. The results thus far obtained indicate that it compares favorably with second-grade pine-tie timber.

The lumber has been extensively used for vehicle stock and for the wooden parts of agricultural implements. It is also made into insulator pins for electric wiring, and is used for furniture and cabinet work, hardwood flooring, trip-hammer beams, the levers of windlasses, and the blocking for oil and wine presses, wood paving, pulley blocks, and belt wheels.

The extensive utilization of gum lumber has hitherto been prevented chiefly by the scanty supply of timber of merchantable size and by the difficulty experienced in seasoning the lumber without warping and checking. It is believed, however, that in the seasoning of gum no greater difficulties will be encountered than in the seasoning of any other hardwood of similar density and strength.

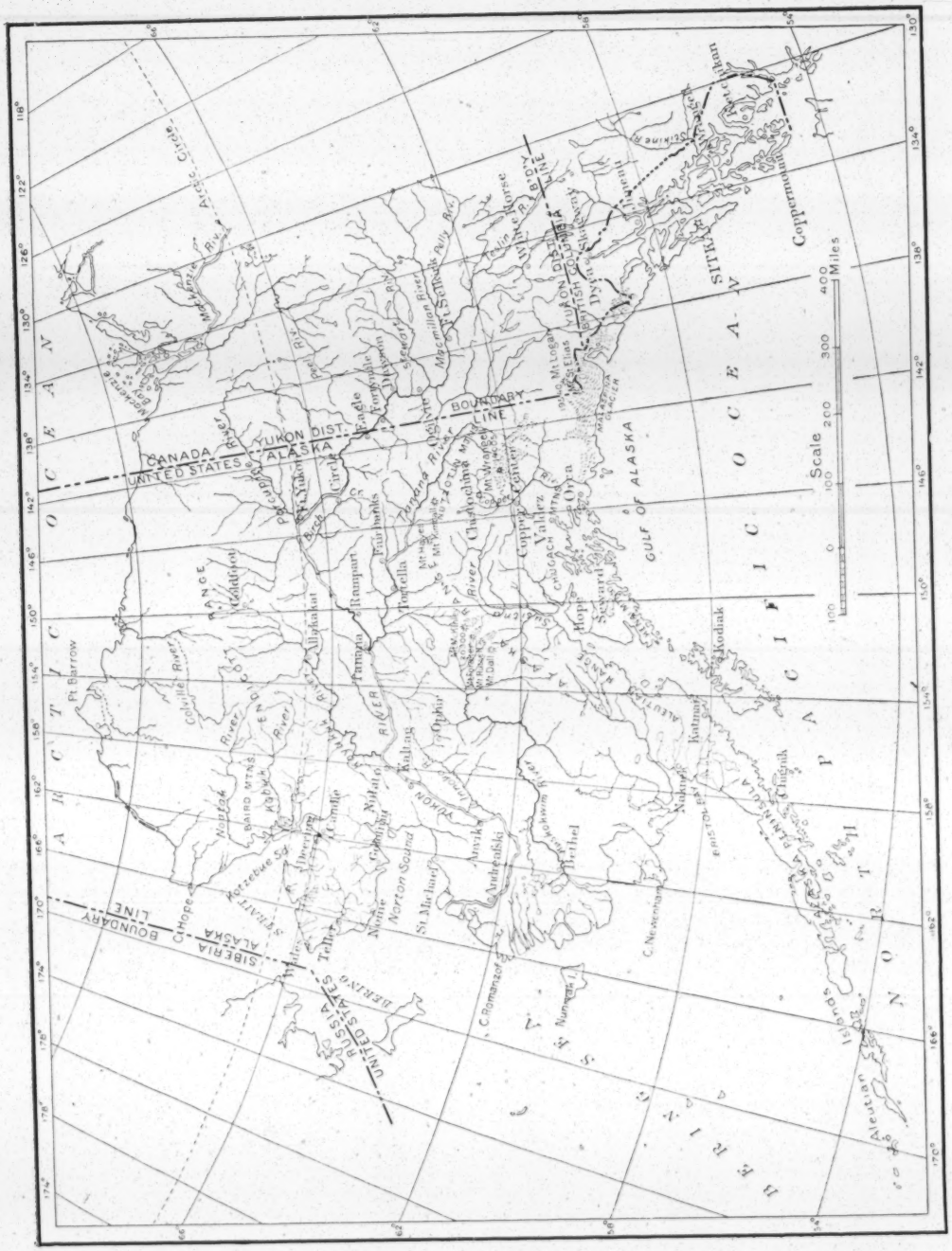
The esteem in which eucalyptus timber is held in California is based upon the exclusive use of blue gum. In Australia, however, this species is considered inferior in strength and timber value to several other eucalyptus. Strength tests of the timber of blue gum and other eucalyptus grown in California have sustained this opinion. It is therefore probable that eucalyptus are destined to enjoy yet greater favor when these other species become more widely used.

A product of considerable importance derived from blue gum is the oil distilled from the leaves. Eucalyptus oil is recognized as a valuable drug and is extensively used by pharmacists and physicians.

In many valleys of California eucalyptus windbreaks are considered absolutely necessary to insure the successful production of crops. They have been most extensively used to safeguard citrus orchards from strong and destructive winds in southern California, but they are now being established also for the protection of vineyards and orchards of deciduous fruits, olives, and walnuts. The blue gum excels other species for windbreak purposes on account of its height and the rapidity of its growth. The tall shafts of the trees bend before the wind and act as a cushion to deflect it upward over an orchard, whereas ordinary windbreak trees form a more solid wall, and the wind draws downward, forming eddies near the leeward side.

Eucalyptus reproduce readily by both seeds and sprouts. The trees bear seed in abundance annually, and under favorable conditions natural reproduction is freely established. Trees also sprout vigorously from both the stump and the roots, either after cutting or in response to injury. In California commercial groves are almost invariably reproduced by sprouts.

Plantations should be started with young trees and not by direct sowing. The opinion is generally held that eucalyptus seedlings are so difficult to raise that their propagation is impracticable except for expert nurserymen. In point of fact, blue gum is one of the most easily propagated species.



OUTLINE MAP OF ALASKA

MAGNETIC OBSERVATIONS IN ALASKA

By Daniel L. Hazard, Coast and Geodetic Survey

ONE of the prime requisites for successful navigation is a knowledge of the magnetic declination or, as the mariner calls it, the variation of the compass, in order that the navigator may properly direct his course when observations of the sun or stars are impossible. The portion of the earth's surface where the compass needle points true north is very limited in extent. Not only does the magnetic north in general differ from the true north, but the amount of difference changes in going from place to place; so that, for example, in crossing the United States from Maine to Seattle the direction of the compass needle would change from 20° west of true north to 23° east of true north.

At the present time the distribution of the earth's magnetism is known at least approximately for the greater portion of the earth's surface, and world charts are issued from time to time by the hydrographic offices of several countries, from which the variation of the compass at any place may be obtained with an accuracy not far short of the needs of the navigator. Up to comparatively modern times, however, no such charts existed, and it was necessary for the navigator to determine the variation of his compass at every opportunity, both on land and on shipboard. Hence the early magnetic data in Alaska, as in many other countries, have been obtained from the accounts of the voyages of those pioneers of the sea who visited that territory either in search of the Northwest Passage, or for the definite purpose of adding to our knowledge of the earth's surface, or perhaps purely from a spirit of adventure. Bering, Cook, La Perouse, Portlock, Meares, Malaspina, Vancouver, Disianski, Kotzebue, Golofnin, Wrangell, Franklin, and many others touched at various places in Alaska and each contributed his share to our knowledge of the earth's magnetism in that part of the world.

Early in the nineteenth century a fresh impetus was given to the study of terrestrial magnetism by the united efforts of von Humboldt, Gauss, Kupffer, and Sabine, and magnetic observatories were established in different parts of the world. In order to secure a wide distribution of stations, it was determined to place one of the Russian observatories in Alaska. In 1841 a wooden building was erected on Japonski Island, just across the harbor from Sitka, and observations were begun in March, 1842, by observers who had been trained for the work at Saint Petersburg. The observations, so far as they have been published, consisted principally of hourly observations of declination from 4 a. m. to 8 p. m., and in some years for the whole 24 hours. The work was kept up until October, 1867, when the territory became the property of the United States.

Since the acquisition of Alaska by the United States, the magnetic survey of the territory has kept pace with the charting of the coast and exploration of the interior, the most of the observations having been made by officers of the Coast and Geodetic Survey. Owing to the unsettled condition and inaccessibility of most of the territory, no attempt has been made to carry out a systematic magnetic survey such as is possible in a fully-developed country. With few exceptions the surveying parties engaged in other work have been provided with magnetic instruments, and magnetic observations have been obtained at one or more places in the area covered by each season's work.

In 1900, when an increase of appropriation made it possible for the Coast and Geodetic Survey to prepare for the erection of several magnetic observatories, the importance of having one in Alaska was recognized and Sitka was selected as the best available location. The site of the old Russian observatory on Japonski Island was no longer suitable;

so the observatory erected in 1901 was placed in the outskirts of Sitka, and there a continuous photographic record of the variations of the earth's magnetism has been obtained since January, 1902. In addition to providing the means for correcting the field observations made in other parts of Alaska, this observatory has contributed an important part to the general study of the earth's magnetism, and in 1906 was visited by Captain Amundsen on his return from the vicinity of the Magnetic North Pole, for the purpose of restandardizing his magnetic instruments.

The observations along the Alaska coast indicate the existence of areas of local magnetic disturbance, of sufficient magnitude, in some cases, to be noticed by the captains of passing steamers. In 1903 a detailed magnetic survey was made of Douglas Island and the vicinity of Juneau for the purpose of investigating one of these locally disturbed areas. A spot was found where the compass needle entirely lost its directive property and the dipping needle stood vertical, showing it to be a local magnetic pole.

In the summer of 1907, in order to supply in part the need of results in the interior, a party was fitted out for magnetic work exclusively, which went down the Yukon River from Dawson to the mouth and secured magnetic observations at numerous places en route. The U. S. Geological Survey and the Alaska Boundary Survey have also contributed to our knowledge of the distribution of declination in the interior.

At the present time we have a good knowledge of the distribution of the magnetic declination along the coast and interior passages from Cape Muzon to Kiska Island, and less detailed data from there to Saint Michael. In the interior we have little information except along the Yukon River and the overland route to the Klondike. As fast as the settlement of the territory advances and new routes of travel are opened, the magnetic survey will no doubt be extended.

AGRICULTURAL CAPACITY OF ALASKA

What Population Can the Territory Support?

By C. C. Georgeson

Special Agent in Charge of Alaska Investigations

THAT Alaska has agricultural possibilities of a sufficiently high order to make it self-supporting is no longer open to dispute. The range of products which can be raised there is, of course, confined to the hardy grains and vegetables of the kind grown in similar latitudes in northern Europe. I am aware that there are still many who doubt that agriculture of any kind is possible in Alaska and for their benefit I will adduce a few facts.

The Government has maintained agricultural experiment stations in Alaska for ten years. The stations, six in number, have been established at different times and in different localities in accordance with the means in hand and the requirements of conditions. Each has been devoted to one or more lines of work suited to the climate and soil. At these various stations all the hardy vegetables have been grown successfully every year. By the hardy vegetables I mean those which are usually grown in northern climates—Brussel sprouts, baricole (kale), broccoli, beets, cabbage, carrots, cauliflower, celery, endive, horseradish, kohl rabi, lettuce, mustard, onions, parsley, parsnips, potatoes, peas, radish,

rhubarb, spinach, rutabaga turnip, and also several of the condiments, mint, sage, dill, etc. All of these can be grown and are grown as far up as the Arctic Circle and beyond. Judge F. E. Howard of Coldfoot, Alaska, 60 miles north of the Arctic Circle, has grown potatoes, cabbage, cauliflower, rhubarb, and even cucumbers with success out of doors in that latitude. That all of these things can be grown, and usually with marked success, can no longer be disputed. They have been and are grown every year in thousands of little garden patches scattered widely over the territory. This is not saying that they can be grown with equal success in all places, and in all conditions, for on the point the elevation, soil, rainfall, and local conditions as to climate are important factors. Nor do I say that there is not now and then a cold summer in which only the hardiest of these things make satisfactory growth. But under normal conditions and with good culture all of these vegetables are grown successfully even beyond the Arctic Circle.

Turning from the vegetables to grains and forage plants, we can point to the fact that at our northernmost experiment station, the one at Rampart, in the Yukon Valley, in latitude 65° 30′, we have never failed to mature barley and oats in the most unfavorable seasons, and in normal years we have also matured winter wheat and winter rye, spring wheat, spring rye, and buckwheat. Clearing and preparation of land began there in 1900, and in 1901 we harvested the first half an acre of ripe barley and oats. As years have passed, the clearing has been extended, but the results have been equally gratifying with each succeeding year. Barley and oats of early and medium maturing varieties have always matured. Winter rye and winter wheat, and even winter barley, have matured at that station whenever the snowfall was deep enough to protect the grains from the low winter temperatures—that is to say, when these grains were covered with 30 inches or more of snow during the coldest period. That snow is the protecting agent is proved by the fact that whenever it is blown off on exposed hill sides the grain is winter killed, but wherever it is piled up in drifts or remains at the normal depth the grain comes through the winter in fine condition and matures during the latter half of August. If these results can be obtained at 65° 30′ north, they can be attained at hundreds of other places south of that latitude. Moreover, these results will be bettered. We have so far been compelled to use seed of plants and crops grown elsewhere in regions differing materially from Alaska conditions. We shall in the near future, by selection and breeding, be able to develop varieties which shall be better suited to Alaska than anything we now have, and it is therefore certain that the results will be improved upon.

So much for the cultivated crops which we know to a certainty can be grown. In addition to that, forage crops for live stock of many species can be successfully grown. Timothy springs up as a volunteer crop along every trail where hay is carried. We have also grown, at the experiment stations, meadow oat grass, meadow fescue, velvet grass, smooth brome grass, Kentucky blue grass, and several legumes. We can grow field peas, vetches, white clover, and alsike clover. These forage plants are not now natives of the country, but they can be made to thrive and furnish feed for livestock on many a mountain side which now produces only plants worthless for feed. But there are also a large number of nutritious grasses, native to the country, which in many places cover large areas with lush growth, on which live stock do well. We depend at present on the native grasses for feed for the cattle and horses at the various stations.

We have started a cattle-breeding station on the island of Kadiak. The cattle, pure-bred Galloways, will be fed and are fed exclusively on Alaska-grown feed. They thrive well on this feed and there is no reason why large herds of cattle and sheep cannot be successfully maintained at many

places in the coast region and also at some points in the interior. The summer and fall in the coast region in Alaska are at times very rainy and there is some difficulty in curing hay, nevertheless, with proper precaution we have never failed to make hay wherever we have kept live stock. Silage can, however, be made with success every year regardless of the rain. In that case the grass is packed in the silo (which is to say a building constructed for the purpose) wet and green as soon as it is cut. This green material undergoes a fermentation which then gives off a smell and has an appearance not unlike sauer-kraut. In this condition it will keep for a year or more and make excellent feed. Cattle are fond of it. One of the best grasses for this purpose is beach rye (*Elymus mollis*). It is a coarse, luxuriant grass, which grows more paricularly on the flat lands along the beach just beyond high tide. At the Sitka station we used work oxen for several years, which were fed during the winter exclusively on silage made chiefly from this grass. One year some was left over, and in August, before the silo was again filled, a portion of this old silage was analyzed and it was found that it had a nutritive value almost equal to good clover hay.

AREA OF AGRICULTURAL LANDS

Alaska has not been surveyed. We have therefore no definite data as to the actual area which can be utilized for agricultural purposes, but I believe that the following estimated figures are approximately correct: The Yukon Valley and the valleys tributary thereto, except the Tanana, 30,000 square miles; the Tanana Valley and its tributaries, 15,000 square miles; The Copper River Valley and its tributaries, 15,000 square miles; the Susitna and the Matanuska valleys, 15,000 square miles; the valleys of the Kuskokwim and the Nushagak rivers, 15,000 square miles, and the coast region 10,000 square miles; total 100,000 square miles, or in round numbers about one-sixth of the area of the entire territory. I do not mean to say all of this is good plow land, but I mean that there is at least 100,000 square miles in Alaska which can be utilized for culture and for pasture, and as a matter of fact the area is probably very much larger since a considerable of the mountain territory will afford pasture. Perhaps these data can be realized more fully if we compare them with similar data of better known areas. The states of New York and Pennsylvania have together an aggregate area of 94,000 square miles, which is less than the agricultural area in Alaska. The combined areas of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, New Jersey, Delaware, Connecticut, and Maryland do not equal the agricultural area of Alaska.

WHAT POPULATION CAN THE TERRITORY SUPPORT?

In the face of these facts it is fair to infer that Alaska can support a permanent population. It would, of course, be too much to assume that Alaska can support a population equal to that of the states mentioned. In 1900, for instance, Massachusetts had a population of 348 persons to the square mile, New Jersey had 252 persons per square mile, New York had 152 per square mile, and Pennsylvania had 140 per square mile. It must not be forgotten, however, that these two large states have extensive mountain and lake areas which are not populated at all, but which are nevertheless counted in these density figures. But is it too much to say that the agricultural area of Alaska can support, and will eventually support, a population of 30 persons per square mile? This is but little more than the average density of the population in the United States exclusive of Alaska and Hawaii in 1900, but including our mountains, deserts, and forest areas, which are now uninhabited. The country which affords the best parallel to Alaska in point of latitude and climate is Finland. It is bounded on the south by latitude 60 and on the north by latitude 70. The main body of Alaska lies within these latitudes, though the two long arms of southeastern and south-

western Alaska extend some eight degrees farther south. Now, Finland has a total area of 148,000 square miles, or, in round numbers, one-fourth the area of Alaska. But one-third of Finland consists of marsh land and inland lakes, and another one-third is forest land. The agricultural area therefore, including the area covered by streams, towns, etc., does not exceed 50,000 square miles. But Finland supports a population of 3,000,000 people, or 60 persons per square mile of area utilized for agricultural purposes. Would it be unreasonable to suppose that the agricultural area of Alaska can, and eventually will, support an equal population of 60 persons to the square mile? If it is not, then Alaska can support a population of 6,000,000 people. But 3,000,000 may be deemed a conservative estimate.

We have reasons for believing that Alaska may equal Finland in agricultural production. Temperature is the chief controlling factor in the production of agricultural crops, and the temperatures, both in the coast region and in the interior of Alaska during the growing season, compare favorably with the recorded temperatures of Finland. The available data of the two countries are, however, not comparable, due to the difference in method of recording the data. In Alaska we base the average temperature on the recorded daily maximum and minimum temperatures—that is, an average temperature which is the mean of these two, while the recorded temperatures of Finland are based on three observations taken at seven in the morning, at two in the afternoon, and at nine in the evening. While these data include the maximum temperature of the day, which usually occurs about two o'clock, they do not include the minimum temperature, which occurs usually some time after midnight, and the mean, based on the three recorded figures, is higher than it would be if the minimum temperature was taken into account. Owing to this difference we cannot draw any accurate comparison, but the facts are we grow vegetables and grains with about the same success that these are grown in Finland. Finland is a noted dairy country. The agricultural exports consist chiefly of butter, cheese, and beef from slaughtered dairy animals. In Alaska cattle feed can be grown in any quantity and it can therefore also become a great dairy country.

DRAWBACKS TO SETTLEMENT

As yet there are but few farmers in Alaska, and these are chifly disappointed prospectors, who have found that they can make more money raising products to supply the local market than they can mining. Nor is there any immediate prospect that the country will be settled with a farming population. Congress has generously enlarged the homestead in Alaska to 320 acres, but even this does not attract prospective farmers except to a very limited extent. The reason is that it is too expensive for a farmer in the states to move his family and equipment to the northland and there begin as a pioneer. Lack of transportation facilities is a barrier at once both to the influx of people and to the export of such produce as they might raise. Until the transportation problem is solved Alaska will have but few immigrants aside from those who come for the purposes of trade and mining, but these conditions will be remedied as the resources of the country are developed. The rich deposits of gold, copper, and coal are bound to be developed, and with this development there will be a general advance, not only in transportation conditions, but in social and economic conditions, and there will be a corresponding growth in the number who take advantage of the agricultural possibilities of the country.

BOOK REVIEWS

In To the Yukon. By Wm. Seymour Edwards. Pp. 237, 6 x 8 in. Illustrated. Map and index. Cincinnati: The Robert Clark Co.

The volume would serve as an excellent guide to one with an inclination to follow the route set forth on the map showing Mr Edwards' itinerary, and it should appeal strongly to the traveler desirous of seeing the wonders of the Northwest country. Beginning at Cleveland, where the trip started, the reader is taken step by step northwest to Winnipeg, Banff, and Vancouver, then on board a ship for the journey into Alaska. The writer, evidently a close observer, gives his narration in a pleasing, straightforward manner, and has acquired the faculty of gathering and summarizing interesting, valuable data. An impartial summing up of conditions that existed in the Canadian Yukon several years ago is given, and the book is illustrated with many photos taken on the trip—actual scenes and happenings which give a very pleasing personal touch. J. O. L.

On the Mexican Highlands. By Wm. Seymour Edwards. Pp. 285, 6 x 8 in. Illustrated. Map and index. Cincinnati: Jennings & Graham Co. $1.75 postpaid.

To one who has never visited Mexico, or is about to go, this volume will give a clear and accurate idea of many quaint Mexican customs, fêtes, ceremonials, and ways of life. The author has a marked gift of narrative and a clear style, which make his book both entertaining and instructive, and the many photographs give color to the Mananaland of which he tells. Some of the best chapters tell of the crowning characteristic of Mexican life, bull fights, financial morality, and antique methods of mining. The descriptions are detailed and full of a freshness of viewpoint most pleasing, and the author gets far enough from the beaten track of the tourist to make it interesting. J. O. L.

Camp-fires on Desert and Lava. By William T. Hornaday. Illustrated. Eight illustrations in color. New York: Charles Scribner's Sons. 1908. $3.00 *net.*

An account of a journey from Tucson, Arizona, across the desert to the little-known region of Pinacate, in northwestern Mexico. The enthusiastic and detailed description of the desert betray the experiences of a "tenderfoot," which Mr. Hornaday frankly admits himself to be. His portrayal of the fauna and flora is vivid and most interesting. The value of the book is greatly enhanced by its fine photographs, and those in color constitute a permanent contribution to our knowledge of the animal and plant life of the border region of Arizona and Mexico. They add greatly to the interest of the volume, which is in general worthy of marked commendation.

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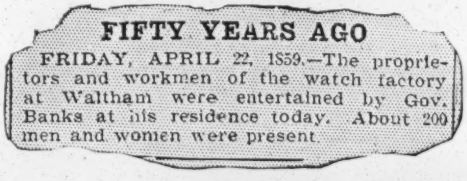
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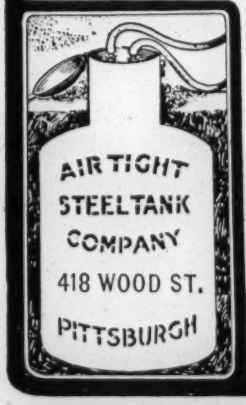

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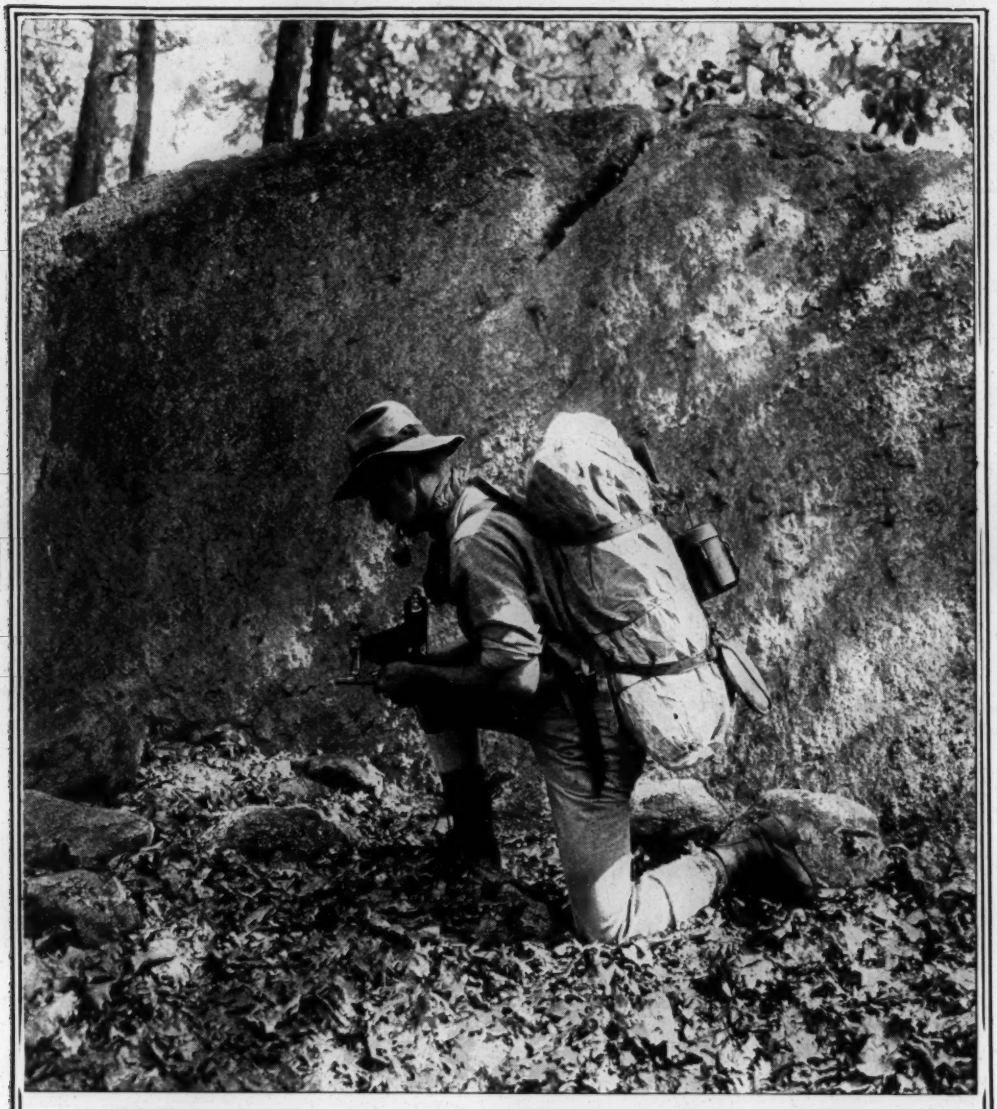

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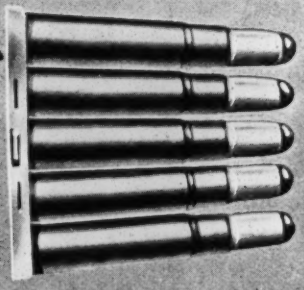

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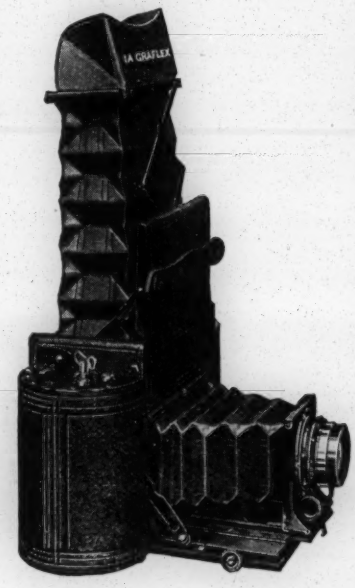

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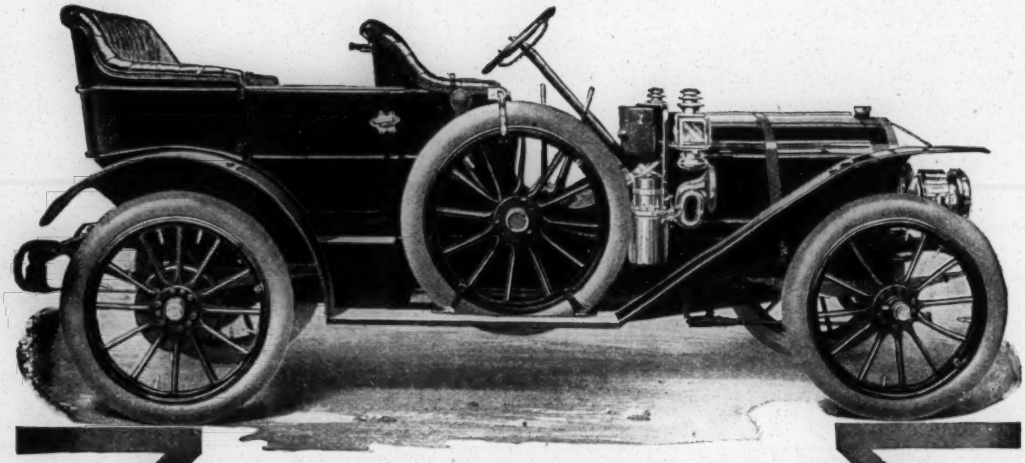

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